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Soil Physics

Abd-El-Samie, A. G., and Marsh, A. W. A TUBE CONTAINING GYPSUM BLOCKS FOR FOLLOWING MOISTURE CHANGES IN UNDISTURBED SOIL. Soil Sci. Soc. Amer. Proc. 19: 404-410. 1955.

The increased use of gypsum blocks for following soil-moisture changes and scheduling irrigations has stimulated efforts to improve their installation, performance, and removal from the field. Gypsum blocks were cast in tubes at 6-inch intervals to simulate the usual practice of installing a series of blocks through the root zone. Three types of block-in-tube constructions were described and results from their use reported. The results indicate that blocks perform satisfactorily when cast in tubes.

The tubes can be quickly installed in an auger or king tube hole, assuring intimate contact with undisturbed soil and roots. The problems associated with backfill are eliminated, and removal at the close of the season is easy. The length of time following installation for equilibrium with the surrounding soil to be reached is reduced.

Archibald, J. A., and Erickson, A. E. CATION-EXCHANGE PROPERTIES OF A NUMBER OF CLAY-CONDITIONER SYSTEMS. Soil Sci. Soc. Amer. Proc. 19: 444-446. 1955.

The cation-exchange properties of bentonite and kaolinite, treated with a wide range of concentrations of a vinyl acetate-maleic acid copolymer, and an isobutylene-maleic acid copolymer were studied. Results obtained by two different methods indicate that there is a definite clay-conditioner interaction between bentonite and these conditioner materials. Very low concentrations of conditioner caused a marked decrease in the cation-exchange capacities of bentonite suspensions. Slightly higher concentrations increased the exchange capacity for both a monovalent and a divalent cation. A further increase concentration resulted in a second decrease in exchange capacity which persisted for all higher conditioner concentrations used.

Babcock, K. L., and Overstreet, R. THERMODYNAMICS OF SOIL MOISTURE: A NEW APPLICATION. Soil Sci. 80: 257-263. 1955.

The authors examine present basic assumptions involved in applying thermodynamics to soil moisture and present a new theory.

Breazeale, E. L., and McGeorge, W. T. EFFECT OF SALINITY ON THE WILTING PERCENTAGE OF SOIL. Soil Sci. 80: 443-447. 1955.

This experiment shows that the technique employed can be used to determine the effect of salinity on the wilting percentage of the soil. It is suggested that the same technique can be employed with other plants that readily develop stem roots in a similar environment.

Bruce, R. R. AN INSTRUMENT FOR THE DETERMINATION OF SOIL COMPACTIBILITY. Soil Sci. Soc. Amer. Proc. 19: 253-257. 1955.

Methods commonly used for determining soil compactibility require a large quantity of soil as well as much time and effort. A method is described which requires only 600-800 gm. of soil and 1 hour of time for each bulk density-moisture curve. The compacter described is of the impact type and easily adjusted for application of a wide range of compaction energies. The procedure adopted applies three to four times as much compaction energy as the standard Proctor method.

A sample weight of 100 ± 5 gm. is satisfactory. As compaction energy increases, the maximum bulk density increases and the moisture content at which it occurs decreases. Compaction data and aggregate stability data from two different experiments show similar differences in soil

physical properties due to soil treatment. In general, this instrument has proved to be very satisfactory for the measurement of soil compactibility.

Chepil, W. S. EFFECTS OF ASPHALT ON SOME PHASES OF SOIL STRUCTURE AND ERODIBILITY BY WIND. Soil Sci. Soc. Amer. Proc. 19: 125-128. 1955.

A cutback asphalt and an asphalt-in-water emulsion were tested for improving soil structure and controlling erosion of soil by wind. The materials applied as fine spray at rates up to 400 gallons per acre, on the basis of undiluted material, produced a film which initially was completely effective in holding various soils against wind. The finer the spray and the more dilute the solution or suspension, the more uniform and stable was the film. The film was effective only for about 2 weeks on clay soil and for at least 2 months on sand and loamy sand.

The film was generally porous and took in rainwater readily. Germination and emergence of wheat, grass, and legume seeds were unaffected by the asphalt film.

Asphalt mixed with soil produced a high degree of soil aggregation in both wet and dry state and decreased erodibility by wind, but only for about 2 years. After this period, the treated soil became progressively more granulated and more erodible by wind but continued to have a substantially greater proportion of water-stable aggregates and to be much more permeable by water. Changes in physical properties of asphaltic cement in soil and its relationship to soil structure and erodibility were recorded and explained. Cement added to soil, it was concluded, will be effective against wind erosion only so long as its sticky property is maintained.

Domby, C. W., and Kohnke, H. THE INFLUENCE OF SOIL CRUSTS ON GASEOUS DIFFUSION. Soil Sci. Soc. Amer. Proc. 20: 1-5. 1956.

A method is described for forming crusts on soils in special containers in the laboratory using artificial rainfall and for measuring gaseous diffusion through these soils without further disburbance of their structure.

Unless the surface is completely impervious, the rate of diffusion through a soil does not depend solely on the properties of this layer. When various proportions of the soil surface were sealed with paraffin, the rate of diffusion was not reduced in proportion to the area covered.

The effects of soil crusts upon diffusion depended to a great extent on the soil-moisture tension. There were no significant differences in the rates of diffusion through air-dry silt loam having different degrees of crusting. Surface crusts on this soil restricted diffusion only at low moisture tensions; the wetter the soil, the greater the influence of the crust on diffusion. Except in the very wet range, even minor variations in soil moisture tension had more influence on diffusion than did the presence of a thin surface crust.

Edwards, D. H. WATER TABLES, EQUIPOTENTIALS, AND STREAMLINES IN DRAINED SOIL WITH ANISOTROPIC PERMEABILITY. Soil Sci. 81: 3-18. 1956.

Two-dimensional steady-state drainage problems were investigated by the method of electric analogues for a soil whose permeability was anisotropic. Solutions for two values of anisotropy are presented, $K_x/K_y = 10$ and $K_y/K_x = 10$, where K_x and K_y denote, respectively, the horizontal and vertical components of permeability. In each case it is shown: (a) How the height of the water table varies with the rate of rainfall for a particular drain diameter; (b) the manner in which the drain diameter is realted to the water-table height for a given rainfall; and (c) how an impermeable bed below the drains influences the flow. The results are discussed by comparing them with published results for isotropic soils. An analytical solution, which is valid for the hypothetical situation of a plane water table and when K_x is greater than K_y is shown to be in reasonable agreement with the present analogue results.

Elrick, D. E., and Tanner, C. B. INFLUENCE OF SAMPLE PRETREATMENT ON SOIL MOISTURE RETENTION. Soil Sci. Soc. Amer. Proc. 19: 279-282. 1955.

The effect of sample pretreatment on soil-moisture retention was measured on eight Wisconsin soils to find the moisture-tension range in which undisrupted soil samples are necessary to represent the moisture relations of field soils. The moisture retention of samples with pretreatments either of 2-mm. sieving or puddling was compared with the retention of undisrupted cores over the moisture-tension range of 0.01 to 15 atm.

In general, the moisture retention of sieved samples of the medium-textured soils studied was increased over core samples at tensions less than 0.4 atm. There was no general relationship in the tension range of 0.4 to 1.0 atm. because of the irregular nature of the release curves of individual soils. Sieving decreased moisture retention about 1 part in 10 at tensions greater than 1.0 atm. Thus sieved samples of the medium-textured soils studied can be used to approximate undisrupted soils in the high tension range with a relative error of 10 percent. Core samples should be used at tensions less than 1.0 atm. to avoid relative errors greater than 10 percent (up to 30 percent).

Gingrich, J. R., and Stauffer, R. S. EFFECTS OF LONG-TIME SOIL TREATMENTS ON SOME PHYSICAL PROPERTIES OF SEVERAL ILLINOIS SOILS. Soil Sci. Soc. Amer. Proc. 19: 257-260. 1955.

Soil cores, 2 inches in diameter and either 1-3/8 or 1-1/2 inches in length, were taken from 6 Illinois soil experiment fields in the late summer and fall of 1952 and from 1 field in the early spring of 1953 to study longtime effects of 3 different soil treatments on permeability to water, moisture percentages at one-third and at 15 atm. pressures, bulk density, noncapillary pore space, and the maximum water available for plant growth. All laboratory determinations were made on the undisturbed soil core except the 15 atm. moisture percentages which were made after drying and breaking up the soil core. The treatments studied were manure, limestone, and rock phosphate; no treatment; and crop residues, limestone, rock phosphate, and potash. These systems of management have been followed for about 40 years at all locations.

The mean values for several determinations differ greatly for the 3 treatments but in only a few cases are the differences statistically significant. The manure, limestone, and rock phosphate treatment was usually the most favorable treatment when significant differences were found.

Grover, B. L. SIMPLIFIED AIR PERMEAMETERS FOR SOIL IN PLACE. Soil Sci. Soc. Amer. Proc. 19: 414-418. 1955.

A simplified basic design is described and utilized in constructing three field air permeameters. The basic design incorporates features of a gasometer and consists of a float, an annular water-filled reservoir, and an inlet tube. The float, which is open-bottomed, rests on the water in the reservoir, to form an air chamber. The inlet tube is affixed to the soil and is also fastened to the inner wall of the reservoir. The air from the air chamber enters into the soil by passing down through a tube, which forms the inner wall of the reservoir, and through the inlet tube into the soil. The float falls as the air enters the soil. The rate of fall is a measure of the permeability. The effective volume of air provided by this type of permeameter is much larger than that provided by previous equipment of similar size. Each of the three field air permeameters was designed for one of these special purposes: (a) to measure permeability to a given depth; (b) to measure permeability to a given depth and be able to use a part of the same equipment for other types of physical measurements, without disturbing the soil; (c) to measure permeability of thin soil layers, as crusts, or silted-over surface soil. Data are given to show the type of results which can be obtained with these permeameters.

Hemingway, R. G. SOIL-SAMPLING ERRORS AND ADVISORY ANALYSES. Jour. Agr. Sci. 46: 1-7. 1955.

Twenty-four sampling units from 50 fields of differing soil type and past manurial history were examined separately for pH and 1 percent citric soluble P and K to determine the errors which can occur in obtaining a representative sample for analysis.

Soils which had received lime and fertilizers within 3 years of the sampling date showed appreciably greater sampling errors than those which had not. The sampling errors were greater than the analytical errors and were such that the common practice of classifying soils into six fertility groups was not justified Three major groups are more reasonable and practical for routine advisory purposes.

Larson, W. E., and Johnston, W. B. THE EFFECT OF SOIL MOISTURE LEVEL ON THE YIELD, CONSUMPTIVE USE OF WATER, AND ROOT DEVELOPMENT BY SUGAR BEETS. Soil Sci. Soc. Amer. Proc. 19: 275-279. 1955.

Experiments were conducted in Montana to determine the effect of soil-moisture level on yield, consumptive use of water, and root development by sugar beets. The studies were made on areas with two water-table depths to determine generally the extent to which sugar beets can use moisture in the moist zone immediately above a water table.

When sugar beets were allowed to remove 43, 75, and 95 percent of the available moisture in the root zone prior to irrigation, yields were 23.4, 22.0, and 16.9 tons per acre, respectively, on an experiment where plants could not obtain ground water. In a second experiment on an area with a water table at 4 to 4.5 feet below the soil surface, yields were 22.9 and 23.5 tons per acre when plants were allowed to extract 54 and 66 percent, respectively, of the available moisture prior to an irrigation. A third treatment not receiving irrigation, but drawing heavily on ground water, yielded 20.1 tons per acre.

Consumptive use of water for the growing season by sugar beets was 23.4, 22.5, and 19.0 inches, depending on whether 43, 75, or 95 percent of the available moisture was removed prior to an irrigation. The largest amount of water was lost from the surface foot of soil in all periods of measurement with progressively smaller amounts from deeper depths on the two wetter treatments. Moisture use was related to the depths containing available moisture in the dry treatment.

Lemon, E. R. THE POTENTIALITIES FOR DECREASING SOIL MOISTURE EVAPORATION LOSS. Soil Sci. Soc. Amer. Proc. 20: 120-125. 1956.

This paper has two objectives: (1) to make available to American workers the results of

Russian work on soil-moisture evaporation suppression; and (2) to lay a background for our present work along these lines, some of which is included.

In the evaporation process, the loss of soil moisture can be divided into three stages. The first stage is that of rapid loss of water where capillary flow to the soil surface is sufficient to meet the evaporative demand of the above-ground environment. The second stage in the evaporation process is one of rapid decline in rate of loss as the soil reservoir is depleted. In this case above-ground conditions are no longer as important but intrinsic soil factors govern the rate of moisture flow to the soil surface. Capillary flow, vapor transfer, and the combination of the two in the capillary condensation evaporation process dominate the picture. The third stage of moisture loss is that of extremely slow rates and is governed by adsorptive forces of molecular distances at the soil liquid-solid interface.

Potentialities for suppressing this rate process lie in the first two stages of moisture loss.

These potentialities group themselves into three categories: (a) Decreasing turbulent transfer of water vapor to the atmosphere by such procedures as, allowing stubble to stand, adding mulching material, increasing soil surface roughness; (b) decreasing capillary continuity by tillage methods or chemical additives of the soil stabilizer type; and (c) decreasing capillary flow and moisture-holding capacity of the surface soil layers by chemical additives of the surfactant type.

Maasland, M., and Kirkham, D. THEORY AND MEASUREMENT OF ANISOTROPIC AIR PERMEABILITY IN SOIL. Soil Sci. Soc. Amer. Proc. 19: 395-400. 1955.

Three fundamental theorems on the movement of air through anisotropic soil are stated. New and simple proofs for two of the theorems are given; proof for one is referred to in the literature. On the basis of these theorems, formulas are derived for converting, to horizontal and vertical permeabilities, airflow measurements, previously reported in the literature, on soil clods. It is shown that the reported values of anisotropic permeabilities are apparent values, and that these apparent values depart considerably, in certain cases, from the correct values. As an extreme example, the reported ratio of the apparent horizontal to apparent vertical permeability for clod samples of Clarion soil, is 2.09, whereas the corrected ratio is 13.0. One particularly interesting general result of the theory is that an apparent value of the vertical permeability is, in fact, the geometric mean of the vertical and horizontal permeabilities of the sample. It is finally shown that the arithmetic mean of the apparent vertical and apparent horizontal permeability does not deviate greatly from the arithmetic mean of the true horizontal and true vertical permeability, the deviation being, for the Clarion sample, only 24 percent.

Miller, E. E., and Miller, R. D. THEORY OF CAPILLARY FLOW: I. PRACTICAL IMPLICATIONS. Soil Sci. Soc. Amer. Proc. 19: 267-271. 1955.

The authors describe elsewhere certain general consequences of assuming that the classical differential equations of surface tension and viscuous flow govern the behavior of liquids within the microscopic pores and channels of an unsaturated porous medium. These consequences appear as macroscopic differential equations expressed in reduced variables and containing two time-independent functionals of pressure which exhibit hysteresis and are characteristic of the medium. The present paper interprets these equations in practical terms.

Because of time independence, the term $\frac{dk}{dp} V K$ appearing in L. A. Richard's analogous equation (1931) becomes $\frac{dK}{dp} V p$. Accordingly, it is possible to solve for the conductivity and capacity functionals from experimental flow system data, provided the accuracy is sufficient for evaluation of required derivatives of pressure.

The combination of reduced variables and time independence permits scale modeling of flow systems. In a small-scale replica, the time scale is shortened, while "gravity" must be increased by means of a centrifuge. One possible application is to laboratory measurement of field capacity.

The reduced variables telescope into groups macroscopic flow systems that are equivalent except for scaling factors. Reducing the microscopic geometry by comparison to a characteristic pore size may prove useful in simplifying physical description of soils.

Miller, S. A., and Mazurak, A. P. AN EVALUATION OF PERMANENT-WILTING PERCENTAGE, 15-ATMOSPHERE MOISTURE PERCENTAGE, AND HYGROSCOPIC COEFFICIENT OF THREE SOILS IN EASTERN NEBRASKA. Soil Sci. Soc. Amer. Proc. 19: 260-263. 1955.

Permanent-wilting percentage, 15 atm. -moisture percentage, and hygroscopic coefficient frequently have been used as indirect measures of the lower limit of readily available moisture for soils in situ. These three methods were evaluated by comparison with a field method for determining the lower limit of moisture readily available to sunflowers growing in Dickinson sandy loam, Wabash silt loam, and Sharpsburg silty clay loam. Since the locations of the soils occurred in a subhumid region, the soil sites were covered with plastic film about the base of the plant stems to rainproof the soils. Soil-moisture percentages from 6 horizons of each of the 3 soils were obtained at frequent intervals during the 11-week growth period preceding plant maturity.

Differences between the lower limit of readily available moisture in the field and the permanent-wilting percentage were relatively small at all depths in the Dickinson sandy loam and Wabash

silt loam, and in the surface foot of Sharpsburg silty clay loam. Permanent-wilting percentages of Sharpsburg silty clay loam at depths of 12 to 18, 18 to 24, 24 to 30, and 30 to 36 inches were markedly less than the values of the lower limit of readily available moisture in the field.

Quink, J. P. SIGNIFICANCE OF SURFACE AREAS CALCULATED FROM WATER VAPOR SORPTION ISOTHERMS BY USE OF THE B. E. T. EQUATION. Soil Sci. 80: 423-430. 1955.

The surface areas of soil colloids and clays determined by low temperature N adsorption and calculated by obtaining the parameter W_m from a B. E. T. plot of water vapor adsorption isotherms were compared. The agreement between these surface areas was not good. The disparity was considered to arise from a variation in the surface density of change of clays and from a tendency of the water molecules to cluster around the cation sites in an arrangement that is not in hexagonal close packing.

Raney, W. A., Edminster, T. W., and Allaway, W. H. CURRENT STATUS OF RESEARCH IN SOIL COMPACTION. Soil Sci. Soc. Amer. Proc. 19: 423-428. 1955.

Discussion of this problem requires separation and careful definition of the kinds of soil conditions ordinarily considered under the general term soil compaction. Implement traffic, tillage operations, and livestock trampling may cause the formation of soil horizons of high bulk density and low porosity in soils which ordinarily have good physical properties. In planning research and extending research results, it is important to distinguish these compacted layers from conditions found in soils with genetically developed pan horizons. Examples of different kinds of both genetically developed and traffic-induced pans are offered.

Reaves, C. A., and Nichols, M. L. SURFACE SOIL REACTION TO PRESSURE. Agr. Engin. 36: 813-816. 1955.

The amount that a confined fragmented soil will compress was found to be proportional to the amount that it has already been compressed. There are two rather definite phases of reaction to pressure in loosely packed confined soil. One phase consists of the collapse of the loose fortuitous structure and the second phase consists of rearrangements of particles that are controlled by cohesion and internal friction.

In the unconfined fragmented soil, distribution of pressure was studied qualitatively and quantitatively. The qualitative study was made with a box which had a glass front coated with levigated aluminum. Any movement of a soil particle in contact with the glass produced a mark in the aluminum, and the general pattern of movement was observed. After an attempt to measure the magnitude of forces in the soil mass with an electric strain gage failed, a lucite cylinder with various sizes of plungers was used to determine the effectiveness of the arch quantitatively, that is, the ratio of pressure absorbed by the wall to the pressure on the bottom at different depths. It was concluded that bulk densities within the limits ordinarily encountered in field soils in good tilth are not an important factor in arch width but that arch width is caused largely by the friction and interlocking of particles with cohesion a secondary factor.

Richards, L. A. A PORTABLE VACUUM FILTER. Soil Sci. 79: 423-425. 1955.

A filtered extract from a saturated soil paste or from a soil suspension is used in various soil tests. The portable filter set described is compact and convenient to use under field or laboratory conditions. The vacuum pump consists of a heavy walled suction bulb with two Bunsen-type valves mounted on a brass stem. The details of construction are given.

Swanson, C. L. W., Ritchie, A., Jr., and Doehne, H. A. COARSE PARTICLE DISTRIBUTION IN THE SKELETON OF SOME COARSE- TO MEDIUM-TEXTURED SOILS. Jour. Soil Sci. 6: 209-218. 1955.

In New England many of the soils are predominantly sandy and gravelly. Because of the intensive agriculture practiced, obtaining quantitative data on the content and distribution of coarse particles in the profiles of these soils are useful in predicting their behaviour in the growing of highly specialized crops. For example, the highest quality cigar tobacco is grown on the coarse-textured soils. A quantitative study of the coarse particles in 10 profiles each of the Hinckley and Merrimac series and 4 profiles each of the Cheshire and Enfield series was made. The Hinckley was outstanding in containing more than 60 percent gravel in the D_1; the Merrimac was intermediate with 25 percent in the D_2; and the Cheshire and Enfield next in order with about 20 percent in the substratum. For the Cheshire and Enfield soils, the gravel content was about 2 percent greater in the A_p horizon of the cultivated soil than in the forested counterpart. Organic-matter losses and compaction decreased their total porosity 25 percent. These factors plus removal of stones for cultivation are thought to account for about one-half of the reduction in thickness of the solum; the rest probably is due to soil removal by erosion.

Taylor, S. A. FIELD DETERMINATIONS OF SOIL MOISTURE. Agr. Engin. 36: 654-659. 1955.

The large errors reported in field studies with tensiometers, resistance units, neutron method, and gravimetric sampling are largely a result of real variation of moisture in the field.

Water is removed unevenly by plants, so that in some parts of the plot water is removed to lower depths and to greater extent than in other parts. A random sampling picks up these variations. Uneven application of water may greatly contribute to unequal distribution in a plot. Even though water may be applied more or less uniformly at the surface, any cracks, discontinuities, or marked changes in structure or texture cause unequal water penetration and distribution.

Veihmeyer, F. J., and Hendrickson, A. H. RATES OF EVAPORATION FROM WET AND DRY SOILS AND THEIR SIGNIFICANCE. Soil Sci. 80: 61-67. 1955.

The rate of evaporation is as rapid from dry soil as from wet soil. This holds true whether the rate is high or low. The rate changes markedly at the permanent wilting percentage.

The fact that, under constant evaporation conditions, the rate of drying of soils is constant until the soil moisture is reduced to the permanent wilting percentage lends support to the finding that water is readily available for transpiration throughout the entire range of soil moisture from field capacity to permanent wilting percentage.

The rate of evaporation measurements may be used to determine the permanent wilting percentage indirectly.

Willis, W. O. FREEZING AND THAWING, AND WETTING AND DRYING IN SOILS TREATED WITH ORGANIC CHEMICALS. Soil Sci. Soc. Amer. Proc. 19: 263-267. 1955.

Laboratory experiments were performed to determine the effects of cycles of freezing and thawing or of wetting and drying on the percentage of water-stable aggregates of soils treated with organic chemicals. The chemicals used were HPAN (a hydrolyzed polyacrylonitrile), SC-50 (a water soluble sodium methyl siliconate) and PR-51 (a water soluble alkylated aromatic sulfonate). Rates of application were 0.1 percent HPAN, 0.2 percent SC-50, or 0.0013 percent PR-51. Seven different soils were tested. Two of the soils were separately treated with HPAN, SC-50, and PR-51, and 5 additional soils were treated only with HPAN. The soils were tested for water stability, by wet sieving, after 0, 1, 5, 10, and 20 cycles of freezing and thawing, and after 0, 1, 5, and 10 cycles of wetting and drying. Results showed that soils which had undergone the effects of freezing and thawing generally had a lower percentage of aggregates 0.25 mm. than those which had not been subjected to the process; this was also true for cycles of wetting and drying but to a lesser extent. The different soils responded with significant difference to the effects of freezing and thawing and of wetting and drying in interaction with the organic chemicals, except that the use of PR-51 resulted in no significant differences.

Soil Chemistry

Allison, F. E. and Roller, E. M. A COMPARISON OF LEACHING AND DISTILLATION PROCEDURES FOR DETERMINING FIXED AMMONIUM IN SOILS. Soil Sci. 80: 349-362. 1955.

Laboratory studies with several NH_4^+-fixing soils, variously treated, are reported.

When such soils were first saturated with NH_4^+ and then leached with various reagents, N NaCl removed the largest portion of the NH_4 whereas N KCl removed the least. The corresponding results with N $CaCl_2$, N $MgCl_2$, and 0.05 N HCl were intermediate and similar.

One suggested method for determining the NH_4-fixation capacity of a soil is to distill a portion of the NH_4^+-treated soil with NaOH and another KOH, and subtract the latter ammonia value from the former. A comparison of values obtained by this distillation procedure with those obtained by the common KCl-extraction method usually gave results that were too low on heated soils. This was due chiefly to the failure of NaOH distillation to remove all the NH_4^+ present. On unheated soils, where the maximum capacity for fixation had not been realized, the distillation method gave results that were too high, because of fixation of some of the readily exchangeable NH_4^+ during distillation.

When the distillation procedure was used on NH_4^+-saturated soils that had been leached with the chlorides of K, Ca, Mg, Na, or H, the NH_4^+-fixation values were markedly below the known NH_4^+ contents of these soils. This was chiefly because these cations interfered with the release of the NH_4^+ when distilled with NaOH. In addition, where the extracted soils were used, subsequent distillation with KOH removed some of the NH_4^+ not removed previously by the various leaching solutions. Where KCl was the extracting agent, little NH_4^+ was removed by distillation with NaOH, indicating that K is fixed more strongly than is NH_4^+ and that it trapped the NH_4^+.

In terms of common laboratory procedures, fixed NH_4^+ can best be defined as that NH_4^+ not removed by extraction with N KCl.

Allison, F. E., and Roller, E. M. FIXATION AND RELEASE OF AMMONIUM IONS BY CLAY MINERALS. Soil Sci. 80: 431-441. 1955.

Ammonium fixation studies with several unweathered, specimen-type minerals are reported. Nine samples of montmorillonite fixed an average of 6.3 me. of NH_4^+ per 100 gr. when leached with N NH_4Cl and heated at 100°C. Leaching of the minerals with 0.05 N HCl prior to leaching with NH_4Cl had little effect, but treatment with N Na_2CO_3 increased the average fixation value by about 70 percent. NH_4^+ was more tightly held in the Na_2CO_3-treated minerals.

Five untreated samples of illite and metabentonite, when leached with N NH_4Cl and heated,

gave fixation values that averaged about 1.0 me. per 100 gr.; a preliminary treatment with N Na_2CO_3 increased the average fixation value to 2.4 me. These low results indicate that the high fixation capacities of many soils, described as illitic, are not due to illite itself but to other minerals, probably vermiculite and montmorillonite, that are formed from illite as a result of weathering with the accompanying loss of K.

Army, T. J., and Miller, E. V. THE INTERACTION OF KIND OF SOIL COLLOID, FERTILITY STATUS, AND SEASONAL WEATHER VARIATION ON THE CATION CONTENT OF TURNIP LEAVES. Soil Sci. Soc. Amer. Proc. 20: 57-59. 1956.

In a study of the effect of environmental factors on cation content of turnip greens, seasonal weather variations from spring to fall were shown to be of similar importance to soil and fertilizer factors.

Divalent cation content of leaves was greater in spring than in fall. Monovalent cation content was significantly higher in the fall than in the spring.

The magnitude of the seasonal effects on cation concentration was modified by the type of clay mineral predominating in the soil and by the percentage soil saturation with Ca and Mg.

The critical level of divalent cation saturation was higher on montmorillonitic than kaolinitic soil. Evidence was obtained for a sharp increase in divalent ion availability between 66 and 76 percent divalent base saturation on the montmorillonitic soil. A higher lime level would be required in fall than in spring especially on montmorillonitic soils.

Bolt, G. H., and Miller, R. D. COMPRESSION OF ILLITE SUSPENSIONS. Soil Sci. Soc. Amer. Proc. 19: 285-288. 1955.

It can be shown that the classical Gouy-Chapman theory of the electric double layer formed on planar surfaces provides an acceptable means of predicting the osmotic pressure of clay suspensions for various particle spacings and electrolyte contents.

Consideration of the implications of these experiments for the mechanism of flocculation favors the following conclusions: (1) The attractive forces acting between clay particles in flocculated suspensions are probably a simple Coulombic attraction between negative and positive sites on the respective particles; (2) Van der Waal's forces are of no consequence in flocculation phenomena in the suspensions studied; (3) the energy of flocculation is small and cannot contribute significantly to the resistance of aggregates to mechanical breakdown.

Bonnet, J. A., Riera, A. R., and Roldan, J. RADIOACTIVE STUDIES WITH P^{32} IN TROPICAL SOILS AND CROPS OF PUERTO RICO. Soil Sci. Soc. Amer. Proc. 19: 283-284. 1955.

Six experiments--3 with sugarcane, 1 with pineapples, and 2 with coffee--were completed in Puerto Rico with P^{32} to determine what percentage of the P was taken by the crop from the fertilizer and from the soil, respectively. Five different methods of applying the fertilizer to coffee trees were also studied. Superphosphate tagged with P^{32} was used. The contents of total P and P^{32} in the crop leaves served as an index for this work.

Bower, C. A., and Goertzen, J. O. NEGATIVE ADSORPTION OF SALTS BY SOILS. Soil Sci. Soc. Amer. Proc. 19: 147-151. 1955.

Samples of Ca- and Na-saturated soils were adjusted to the saturation moisture percentage with chloride salt solutions having concentrations of about 10, 100, and 1,000 me./l. After equilibration, successive fractions of the salt solutions consisting of that removed between suctions of 0 to 1, 1 to 4, 4 to 8, and 8 to 16 atm. were obtained by the use of a pressure-membrane apparatus. Chemical analyses of these fractions and determinations of the Cl concentrations of the solutions remaining in the soils after extraction at 16 atm. of suction showed pronounced gradients in the salt concentrations of soil solutions, the solution retained at the higher suctions having lower concentrations. The concentration gradient was much greater for Na-saturated than for Ca-saturated soil except at the highest salt level employed.

The negative adsorption of various salts by soils was determined quantitatively from surface area measurements by ethylene glycol retention and from the difference between the true amount of salt present and that indicated by analysis of a saturation extract obtained at a suction of about one-half atmosphere. For three Ca-saturated soils the negative adsorption of $CaCl_2$ was nearly the same at equivalent concentrations in the saturation extract, the values at concentrations of 10, 100, and 1,000 me./l. being about 5×10^{-6}, 35×10^{-6}, and 290×10^{-6} me./sq.m., respectively. The negative adsorption of NaCl and Na_2SO_4 by Na-saturated soils was similar to but greater than that of $CaCl_2$ by Ca-saturated soils at equivalent concentrations in the saturation extract.

Breazeale, E. L., and McGeorge, W. T. SPECIFICITY OF VOLTAGE POTENTIALS IN CATION UPTAKE BY PLANTS. Soil Sci. 80: 319-324. 1955.

Experiments presented here indicate voltages of 2.10, 2.13, 2.20, and 2.23 represent points of

maximum uptake of the respective cations rather than the actual specific voltages. There is an overlapping range in cation uptake, and this is greatest for cations with the voltages in closest proximity. The degree of overlapping varies with the length of time the plants are continuously held at the different voltages.

Bremner, J. M., and Shaw, K. DETERMINATION OF AMMONIA AND NITRATE IN SOIL. Jour. Agri. Sci. 46: 320-328. 1955.

Methods for determining ammonia and nitrate in soil are described. The ammonia and nitrate are extracted at pH 1.0-1.5 with a mixture of P sulphate and sulphuric acid, and the ammonia is determined by distillation with Mg oxide at 25° C. in a modified Conway microdiffusion unit. Ammonia plus nitrate is determined on a separate sample of the same extract by reduction of the nitrate to ammonia with titanous hydroxide and subsequent distillation with Mg oxide, both the reduction and distillation being carried out in a modified microdiffusion unit at 25° C.

Brown, D. A. ION EXCHANGE IN SOIL-PLANT ROOT ENVIRONMENTS: II. THE EFFECT OF TYPE OF CLAY MINERAL UPON NUTRIENT UPTAKE BY PLANTS. Soil Sci. Soc. Amer. Proc. 19: 296-300. 1955.

This investigation was designed to measure the effect of the percentage of kaolinite, montmorillonite, and illite clay minerals upon nutrient uptake by soybean plants. A kaolinite-montmorillonite and a kaolinite-illite series of clay mixtures were prepared through the range of 0 to 100 percent kaolinite-montmorillonite and 0 to 100 percent kaolinite-illite. Each clay mixture was mixed with nutrient-free quartz sand to give 15-percent clay by weight. The sand-clay mixtures, saturated to 70-percent Ca, 10-percent Mg, and 5-percent K, were placed in root development pans, and soybean plants were planted and grown between the collodian membranes for 4 weeks as described in previous studies. This enabled a measurement of the effect of the type of clay mineral upon nutrient uptake.

Within the kaolinite-montmorillonite series, each increment of montmorillonite added altered the shape of the titration curve, and the exchange capacity in direct proportion to the percentage of montmorillonite clay present. This effect was also for the kaolinite-illite clay series. The experimental exchange capacity values of each clay mixture agreed with its calculated value, indicating that there was no gain or loss in the exchange capacities of the individual clay minerals upon mixing. Only 5-percent montmorillonite and 10-percent illite were necessary to dominate the chemical properties of the kaolinite clay minerals.

Brown, D. A., and Noggle, J. C. ION EXCHANGE IN SOIL-PLANT ROOT ENVIRONMENTS: I. MEASUREMENT OF SUITES OF CATIONS AT VARIOUS STAGES OF NUTRIENT UPTAKE. Soil Sci. Soc. Amer. Proc. 19: 131-134. 1955.

Increasing the percentage of Mg resulted in an increase in the percentage of Mg and a corresponding decrease in the percentage of Ca and K in the suite of cations at each stage of nutrient uptake. Ca dominated the suite of adsorbed cations on plant roots grown in Ruston soil, while K dominated the suite of adsorbed cations on plant roots grown in Sharkey soil. The Sharkey soil produced plants with Ca percentages of less than one-fourth of those grown on the Ruston soil despite the fact that with equal percentages of Ca saturation (65 percent) the Sharkey clay offered about 10 times the quantity of exchangeable Ca to the plant roots. A Mg saturation of 9 percent of the Ruston soil produced plants with equal Mg contents (0.30 percent) as did the Sharkey clay with 3-percent Mg saturation. The exchange properties of the plant root and the metabolic effects of the plant favored a greater movement of K than Mg or Ca from the root surface into the roots and tops of the plants.

Chichilo, P., Specht, A. W., and Whittaker, C. W. DETERMINATION OF CERTAIN ELEMENTS IN AGRICULTURAL LIMESTONES BY GROUP SEPARATION AND SPECTROGRAPHY. Jour. Assoc. Official Agr. Chem., pp. 904-912. Nov. 1955.

A method is described for the simultaneous spectrochemical determination of Al, C, Cu, Fe, Mg, Mo, V, and Zn in limestone. These elements are first separated from most of the Ca and Mg by precipitation with oxine and tannic acid from solutions buffered at pH 5.9 with ammonium acetate. The filtered and washed precipitates are ashed to remove organic matter; the residue is taken up with 1:1 hydrochloric acid; and aliquots are arced in the spectrograph. Indiam is used as an internal standard for Co, Cu, Mn, Mo, and V. Aluminum, Fe, and Zn are best determined by the comparison standard technique. Results agreed in most cases within 15 percent with results for several elements by other laboratories. The procedure avoids the usual weighing and mixing of the ash with base material and the weighing of aliquots. Previous group separation methods with oxine did not include Mn in the elements determined simultaneously.

Clark, J. S., and Peech, M. SOLUBILITY CRITERIA FOR THE EXISTENCE OF CALCIUM AND ALUMINUM PHOSPHATES IN SOILS. Soil Sci. Soc. Amer. Proc. 19: 171-174. 1955.

The solubilities of Ca phosphates may be represented on a single solubility diagram in which

functions of the chemical potentials of $Ca(OH)_2$ and $CA(H_2PO_4)_2$ are used as co-ordinates. In the presence of solid phase $CaCO_3$, the chemical potential of lime (the value of pH- 1/2pCa) depends upon the partial pressure of CO_2 in the atmosphere. Solubility determinations showed that neither dicalcium phosphate nor hydroxyapatite was present in the soil or clay systems studied.

A similar solubility diagram may be constructed for the Al phosphates using functions of the chemical potentials of $Al(OH)_3$ and $Al(H_2PO_4)_3$ as co-ordinates. In the absence of reliable solubility data, the existence of the Al phosphates in the soils studied could not be established.

Ehrlich, W. A., Rice. H. M., and Ellis, J. H. INFLUENCE OF THE COMPOSITION OF PARENT MATERIALS ON SOIL FORMATION IN MANITOBA. Canadian Jour. Agr. Sci. 35: 407-421 1955.

The analysis of major horizons of 10 soil profiles was undertaken in an attempt to ascertain the effect of the composition of parent material on soil formation in well-drained Mankato till sediments, under various environmental conditions. The results showed that the composition of parent materials had a profound effect on the type of profile formed. Increasing amounts of inorganic carbonates restricted profile development and inhibited the decomposition of noncalcareous rock fragments. The amount of inorganic carbonates in the parent material has been a major factor in determining and differentiating certain great soil groups; furthermore, the mineralogical composition of the parent material also has been a determining factor in the formation of Brown Podzolic and Podzol soils. Weathering of noncalcareous minerals and rocks (except shale) was comparatively slight; examination of the clay fraction revealed about equal percentages of the dominant types in each horizon.

El Gibaly, H., and Axley, J. H. A CHEMICAL METHOD FOR THE RATING OF AGRICULTURAL LIMESTONES USED AS SOIL AMENDMENTS. Soil Sci. Soc. Amer. Proc. 19: 301-302. 1955.

A method for calibrating the efficiency of both calcitic and dolomitic limestone in relation to their rapidity in correcting acidity in soils is proposed. The procedure follows:

Exactly 1.0 gm. of the limestone to be tested is added to 250 ml. of boiling 0.07 N disodium ethylene-diaminetetraacetate which is contained in a 500-ml. Erlenmeyer flask connected to a reflux condenser. After refluxing 20 minutes, 10 ml. of ammonia buffer solution (ph 10) is rapidly added. The solution is immediately titrated with 1.0 N magnesium sulphate solution using Eriochrome black T as indicator. The end point is attained when the color of the indicator changes from blue to wine red. Time and rate of heating must be controlled precisely.

Limestone samples are calibrated from these titration results by comparing them to the reaction of calcite under identical conditions.

Elgabaly, M. M. SPECIFIC EFFECTS OF ADSORBED IONS ON PLANT GROWTH: I. EFFECT OF DIFFERENT CONCENTRATIONS OF CALCIUM, MAGNESIUM, AND SODIUM ON BARLEY SEEDLINGS. Soil Sci., Vol. 80, No. 3, pp. 235-248. Sept. 1955.

The specific effects of absorbed Na^+, Mg^{++}, and Ca^{++} on the growth and cationic accumulation by barley plants were studied in resin-sand systems. Dry weight, length of shoots, and length of roots were used to measure the effects of ions on plant growth. Roots were found to be more sensitive to the cations in the environment, as shown by difference between maximum and minimum length.

Growth was better in systems having a concentration of any two cations, within a given range, than in homoionic or pure sand system. The range within which stimulation took place varied with the nature of the two cations, being narrower for Na-Mg-systems, wider for Ca-Mg-systems, and intermediate for Na-Ca-systems.

The effects of a given cation are modified, therefore, by the nature of complementary ions. For Na^+, this effect is different when Ca^{++} is the complementary ion from that when Mg^{++} is the complementary ion. This is true also for Mg^{++} and Ca^{++} ions.

Ellis, R., Jr., and Truog, E. PHOSPHATE FIXATION BY MONTMORILLONITE. Soil Sci. Soc. Amer. Proc. 19: 451-454. 1955.

The factors involved in fixation of P, added as $Ca(H_2PO_4)_2\ H_2O$, by montmorillonite clay were investigated. The influence of the free Fe and Al oxides, which accompany this clay, on the fixation was determined by measuring fixation before and after removal of these oxides. The free Fe and Al oxides accounted for most of the fixation against weak acid extraction. No appreciable fixation against water extraction occurred when the free Fe and Al oxides were removed and the clay was H-saturated.

The influence of saturation of the clay with the exchangeable cations usually found in soils on P fixation was investigated. Ca-saturation clay, treated to remove free Fe and Al oxides, fixed large amounts of P against water extractions. However, this P was recovered by weak acid extraction. The evidence obtained in this investigation indicates that the P fixed by Ca-saturated clay is fixed as Ca phosphate complexes, and not by a H_2PO_4-Ca-clay bonding as has been proposed. Clays which were saturated with Na, K, or Mg, fixed only small amounts of P against water extraction.

Evans, E., and Gottlieb, D. GLIOTOXIN IN SOILS. Soil Sci. 80: 295-301. 1955.

Two isolates of Penicillium terlikowski and one of Trichoderma viride were tested for

gliotoxin production with spores of Sclerotinia fructicola used for assay purposes; the progressive development and later recession of toxicity in the culture medium were followed. Only part of the gliotoxin added as a component of the culture filtrate was recovered in the extracts; the amount recovered was not correlated with pH within the range 4.7 to 6.2. Tricoderma viride produced a maximum concentration of 3.125 mg. at laboratory temperature. No such toxic material could, however, be detected in unamended nonsterilized soil.

Fried, M., and Dean, L. A. PHOSPHATE RETENTION BY IRON AND ALUMINUM IN CATION EXCHANGE SYSTEMS. Soil Sci. Soc. Amer. Proc. 19: 143-147. 1955.

Phosphate retention by a kaolinitic soil clay and cation exchange resins was studied to evaluate both the nature of retention and the effect of cations on the system. Calcium in the system always effected greater retention of phosphate by the exchange material than did Na.

Surface coatings of Fe or Al on the exchange material retained a large proportion of the added phosphate. The amount of this retention increased as the concentration of P in solution increased.

The percentage of the retained phosphate that exchanged with radiophosphorus in solution was a function of both the concentration of P in solution and the length of time allowed for equilibration. The coated resins and a soil clay acted similarly.

Hagen, C. E., and Hopkins, H. T. IONIC SPECIES IN ORTHOPHOSPHATE ABSORPTION BY BARLEY ROOTS. Plant Phys. 30: 193-199. 1955.

Association of the binding sites involved in phosphate absorption with roots describes a heterogeneous system. Although the general kinetic treatment employed in this paper is applicable to both homogeneous and heterogeneous reactions, certain restrictions are imposed on the results obtained from heterogeneous systems.

Consideration of equilibrium in intermediate complex formation necessitates assignment of concentration values for the intermediate complexes, $R_aH_2PO_4$ and R_bHPO_4-, and the binding sites, R_a^+ and R_b^+. The units of concentration are expressed in respect to the external system and do not indicate the concentration of the sites in the roots, per se. Since the absolute concentrations of the binding sites are not known, it is evident that constants describing reactions with these sites must be recognized as apparent or relative constants. Under the experimental conditions, it has been shown that the greatest amount of ($R_a^+ + R_b^+$) effective in phosphate absorption from the external solution is approximately 1×10^{-8} moles. The measured maximum absorption for each reaction is expressed by an ($Rk_3t + R$) which dictates that varying amounts of R^+ are compensated by changing values of k_3.

Since the moles of R+ have been assumed to be equivalent to the concentration of R^+ in respect to the external system, it can be shown that only (R+) of 1×10^{-6}M or greater significantly affect the equilibrium as described by equation 19. The assignment of the highest value to the concentration of the binding sites is not critical to this analysis since (R+) is 1×10^{-8}M, or less.

/Hoffman, W. M., Olive, B. M., and Hill, W. L. DETERMINATION OF WATER-SOLUBLE PHOSPHORUS IN FERTILIZERS BY REPEATED WASHING AND BY DIGESTION. Jour. Assoc. Official Agr. Chem., pp. 889-897. Nov. 1955.

Two procedures, typical of general methods for extracting phosphate fertilizers with water, were applied to a variety of materials for comparison of the magnitude and precision of the results obtained by these two methods. The findings of this study are presented.

Jurinak, J. J., and Thorne, D. W. ZINC SOLUBILITY UNDER ALKALINE CONDITIONS IN A ZINC-BENTONITE SYSTEM. Soil Sci. Soc. Amer. Proc. 19: 446-448.

The possibility of zincate formation in alkaline soils was investigated. Utah bentonite suspensions were titrated to 1/2, 1, and 2 percent of their base-exchange capacities with Zn^{65} in Zn chloride. The pH of the suspensions was varied by treatment with Na, K, or Ca hydroxide. After a period of shaking, the suspensions were centrifuged and the supernatant liquid analyzed for Zn^{65}.

In both the Na and K systems, Zn solubility reached a minimum in the pH range of 5.5 to 6.7. As the alkalinity of the systems was increased, the solubility of Zn also increased. This suggests the formation of soluble alkali zincates. In the Ca system, Zn solubility reached a minimum at a pH of 7.6, and no increase in soluble Zn was noted as the pH of the system was increased. The formation of insoluble Ca zincate can be postulated. Since analyses did not reveal the ionic species of Zn in solution, this study can only be regarded as circumstantial evidence in support of zincate formation in alkaline soils.

Kelley, O. J. THE RELATION OF SOIL WATER LEVELS TO MINERAL NUTRITION OF SUGAR BEETS. Amer. Soc. Sugar Beet Tech. Proc. 8 (II): 344-356. 1954.

This study considered water in its role in nutrient uptake. Water is important in nutrient uptake of plants in four ways. They are:

(1) It is a medium through which nutrients must pass to be taken from the surface of the root into the inner vacuole. (2) Too much water may have an adverse effect insofar as root ac-

cumulation of nutrients is concerned in the following ways:

(a) Limiting root growth by low oxygen concentrations or development of toxic substance.

(b) Leaching of nutrients below root zone.

(3) Too little water affects the concentration of nutrients in soil and their availability to plants. (4) There appears to be a relation between nutrient uptake and variations of moisture content between field capacity and wilting percentage. In sugar beets, the P content is increased with increasing soil-moisture content, while the N content is decreased and is affected to a greater extent than P.

Kittrick, J. A., and Jackson, M. L. RATE OF PHOSPHATE REACTION WITH SOIL MINERALS AND ELECTRON MICROSCOPE OBSERVATIONS ON THE REACTION MECHANISM. Soil Sci. Soc. Amer. Proc. 19: 292-295. 1955.

The phosphate reaction rate for several soils was very rapid initially, but diminished to lower values in a matter of minutes. For example, the rate of phosphate reaction with a Catalina Latosol after 3 minutes of contact was 100 tons of superphosphate per acre per hour but after 1 month the rate of reaction had fallen to about 1 pound per acre per hour. Removal of extractable Fe oxides from the Catalina soils greatly diminished the rate of reaction of phosphate with the soil but reaction with the kaolinite portion was nearly half of the total. It was possible to produce colloidal Fe oxide and Al hydroxide particles analogous to the reactive surfaces responsible for the rapid initial reaction of phosphate with soil minerals. Electron microscope observations of these minerals in contact with phosphate solution disclosed the formation in a few minutes of separate-phase phosphate crystals by the mechanism of solution-precipitation. These experiments suggest that the solution-precipitation mechanism is important in phosphate fixation in soils.

Kittrick, J. A., and Jackson, M. L. APPLICATION OF SOLUBILITY PRODUCT PRINCIPLES TO THE VARISCITE-KAOLINITE SYSTEM. Soil Sci. Soc. Amer. Proc. 19: 455-457. 1955.

The reaction of variscite with H^+ and OH^- in water solutions was investigated and the (OH^-) exponent in the variscite solubility product expression was dependent upon solution pH, being proportional to $(OH^-)^2$ only at pH 4. An increase from 1 to 10 gm. of kaolinite to 0.5 gm. of variscite in 50-ml. volume increased the Al concentration in solution from 2.3×10^{-5} to 4.8×10^{-5} molar and diminished the phosphate concentration in solution from 2.5×10^{-4} to 0.7×10^{-4} molar in accord with solubility product principles.

Krishnamoorthy, C., and Desai, A. D. KINETICS OF EXCHANGE BETWEEN ADSORBENTS: IV. UNEQUAL VALENCY ION PAIRS. Soil Sci. 80: 325-333. 1955.

The rate of exchange of unequal valency ion pairs is very slow, about 6 months being required to reach complete equilibrium. The disagreement between observed and expected constants in adsorbent-adsorbent systems involving unequal valency pairs is due to slow rate of reaction and inclusion of hydrolyzed ions in the fine fraction. Gel diffusion is characteristic of exchange of unequal valency ion pairs.

Low, P. F. EFFECT OF OSMOTIC PRESSURE ON DIFFUSION RATE OF WATER. Soil Sci. 80: 95-100. 1955.

An equation was developed relating the hydraulic and osmotic pressure gradients to the rate of diffusion of water. It shows that the osmotic pressure acts as a negative hydraulic pressure in its influence on water diffusion. The equation was tested for clay suspensions and shown to be valid.

Lynch, D. L., Wright, L. M., and Cotnoir L. J., Jr. THE ADSORPTION OF CARBOHYDRATES AND RELATED COMPOUNDS ON CLAY MINERALS. Soil Sci. Soc. Amer. Proc. 20: 6-9. 1956.

Studies were made with the adsorption of carbohydrates on clay minerals. The carbohydrates utilized were ethyl cellulose, methylcellulose 15 cps, cellulose dextrin starch dextrin, inulin, glycogen, corn polysaccharide, hydroxyethylcellulose, carboxymethylcellulose, corn starch, and sucrose.

These carbohydrates were adsorbed on both a Ca and H saturated montmorillonitic type clay. A Ca saturated kaolinitic type clay was also used.

Increasing increments of carbohydrates, ranging from 26 mg. to as much as 450 mg. in certain cases, were added to 1-gr. samples of the clays. Twenty ml. of water was added, and the materials were thoroughly mixed by mechanical shaking for 48 hours. The clays were allowed to stand 96 hours to attain equilibrium and were centrifuged. The clear supernatant liquid was then tested for carbohydrate by the anthrone reaction. The difference between the amount of carbohydrate added and the amount in the supernatant liquid was taken as the amount adsorbed on the clay.

Adsorption on the calcium saturated kaolinitic clay ranged from 0.0 to 3.7 percent. The greatest amount of adsorption on bentonite, the montmorillonitic type clay, was with ethyl cellulose, starch, and cellulose dextrin, 20.5, 21.6, and 12.4 percent, respectively. Little difference was noticed between the Ca and H saturated clays.

X-ray diffraction analyses demonstrated that the carbohydrate materials were adsorbed between the interplanar spacings of the montmorillonitic clay. Infrared spectra analysis suggests that H bonding plays a role in the adsorptive mechanism. Extractions with bases, acids, and salts suggest that cation and anion exchange are not involved in the adsorption of these carbohydrates.

Martin, R. T. ETHYLENE GLYCOL RETENTION BY CLAYS. Soil Sci. Soc. Amer. Proc. 19: 160-164. 1955.

By the inclusion of a free glycol surface with each batch of samples, the glycol retention method of Dyal and Hendricks is modified to give an equilibrium glycol retention value that is a constant for a given sample over a wide range of initial drying conditions. Within fairly wide limits, sample size, temperature, and free Fe oxides have little effect on the equilibrium glycol retention value. Milligrams of glycol per gram of calcium saturated montmorillonoid or illite clay range from 260 to 295 and 65 to 80, respectively. Even at very low glycol retention values the experimental error does not exceed 5 percent. As well as retaining the highly desirable features of the original method, a simple gravimetric procedure requiring a minimum of special equipment, the proposed modification gives a definite equilibrium value and requires a small sample (0.2 gm.). Relations between glycol retention, exchange capacity, and percent K_2O are discussed for hydrous micas from mica to montmorillonoid.

McAuliffe, C., and Coleman, N. T. H-ION CATALYSIS BY ACID CLAYS AND EXCHANGE RESINS. Soil Sci. Soc. Amer. Proc. 19: 156-160. 1955.

Except where complicated by the adsorption or the limited diffusion of the molecular reactant, rates of H-ion catalyzed hydrolysis of ethyl acetate or inversion of sucrose were proportional to the concentrations of H-ions in a variety of ion exchange systems. No correlation existed between potentiometric H-ion activities in clay or exchange resin suspensions and their efficiencies as catalysts.

McLean, E. O., and Adams, D. FURTHER CHARACTERIZATION OF ARKANSAS SOILS BY CATIONIC ACTIVITY MEASUREMENTS. Soil Sci. Soc. Amer. Proc. 19: 151-155. 1955.

The results indicate that even though kaolinite is doubtlessly present in considerable quantity in the Ruston soils, montmorillonite clay appears to exert a strong if not dominant influence in regulating the cationic interactions in these soils. Beidellite clay seems to play the major role in the Sharkey and Houston soils. Although not as striking as in the case of the Sharkey soil studied previously, the < 25 mμ fraction from the Houston soil seems to be influenced by montmorillonite. The 50 to 200 mμ fraction is more characteristic of beidellite, and the 25 to 50 mμ fraction is intermediate between montmorillonite and beidellite in characteristics of the K active-base saturation curve. The crude humic acid fraction separated from the Houston soil was not markedly different from that studied previously from a Sharkey soil.

Murphy, W. S., Hunter, A. H., and Pratt, P. F. ABSORPTION OF RUBIDIUM BY PLANTS FROM SOLUTION AND SOILS. Soil Sci. Soc. Amer. Proc. 19: 433-435. 1955.

The absorption by plants of Rb from soils and sand was measured. The Rb was added to the soil as RbCl, and in the sand culture various ratios of K to Rb were used. Corn was grown in the soils and the distribution in the plant and soil determined. Beans were grown in the culture solutions, and the distribution of K and Rb measured in the various plant parts.

The percent recovery of Rb by the corn plant from three soils was inversely related to the K in the soil. The K to Rb ratios in the plants showed high correlation with HNO_3-soluble K. The percent of the added Rb fixed against extraction with NH_4 OAc or HNO_3 during the 11-week growing period was small.

Where bean plants were grown in sand culture with various ratios of K and Rb, the molar ratios of K and Rb in the plants differed somewhat from those in the solutions. There was also a significant difference between the K/Rb ratios in the various plant parts. Growth and fruit production in beans were reduced where the molar ratios of K to Rb were less than 5/1.

Nelson, J. L., and Melsted, S. W. THE CHEMISTRY OF ZINC ADDED TO SOILS AND CLAYS. Soil Sci. Soc. Amer. Proc. 19: 439-443. 1955.

The chemical forms which zinc assumes when added to soils and clays were investigated, using the isotope dilution technique (with Zn^{65} as a tracer). After equilibrium, the added Zn was extracted by successive leaching with neutral normal NH_4 Ac, 2.5 percent HAc, and 0.1 N HCl. Variables were: (1) time of equilibrium, (2) Ca saturation, (3) amount of Zn added, (4) rate of extraction, and (5) type of clay mineral.

With symmetry additions of Zn and a H soil system, practically all of the Zn taken up by the soil was replaceable with NH_4Ac, whereas in a Ca soil system a part of the Zn could not be replaced with NH_4Ac. The portion of the Zn not removed with NH_4Ac could be extracted by repeated leaching with dilute HCl. This acid-soluble form of Zn increased with increasing length of time of contact between the soil and the Zn solution. It apparently did not occupy exchange sites in the soils, since there was no reduction in

the base-exchange capacity of the soil with the formation of the acid soluble form. As smaller quantities of Zn were added to these soils and as the amount of time following the addition increased, a higher proportion of the Zn was in the acid-soluble form.

Perkins, A. T., Dragsdorf, R. D., Lippincott, E. R., Selby, J., and Fateley, W.G. PRODUCTS OF CLAY MINERAL DECOMPOSITION AS RELATED TO PHOSPHATE FIXATION. Soil Sci. 80: 109-120. 1955.

A series of eight aluminum silicate minerals were ground for periods up to 21 weeks. This grinding was considered to yield products similar to those that might be formed by weathering under field conditions. The ground material was examined by a number of methods, including analyses of chemical composition, chemical characteristics, infrared spectra, X-ray spectra, and electron micrographs. Each type of analysis indicated that despite great difference in chemical composition, reaction, and mineral species, grinding produced similar products, one of which is, or resembles, an alumina-silica gel. That the decomposition of the minerals yields a product that would react with phosphate to precipitate it indicates that decomposition of the soil clay minerals might be responsible for a major part of the phosphate fixation in soils.

Richards, L. A. PORTABLE CONDUCTIVITY BRIDGE AND CELLS FOR SALINITY APPRAISAL. Soil Sci. 80: 55-59. 1955.

The trend in scientific agriculture is to base management operations on factual information. Excess soil salinity is a continual hazard where irrigation is practiced, and there is little doubt that greater operating efficiency can be attained in many areas if information of the salinity status of soil and water can be made more readily available.

Electric bridge measurements have long been used for the appraisal of soil salinity, and the U. S. Salinity Laboratory recommends the conductivity of the saturation extract as a salinity index for general agricultural use. A portable vacuum filter and the electric measuring set here described were developed to simplify and facilitate this measurement.

Schofield, R. K., and Taylor, A. W. THE MEASUREMENT OF SOIL pH. Soil Sci. Soc. Amer. Proc. 19: 164-167. 1955.

A number of experimental results are presented which show the variation of the pH values of several soils when samples of each are shaken with $CaCl_2$ solutions of different concentrations.

These results are then interpreted on the basis of the ratio law--derived from the Gouy theory of the electrical double layer-- and it is shown that the pH values and electrolyte concentrations show the expected relationship, provided the latter is not too large.

The importance of the connection between pH and electrolyte concentration in the routine measurement of soil pH is emphasized, and it is pointed out that such measurements must be carried out using an electrolyte solution of known composition in order to obtain comparable results from different soils.

Sowden, F. J. ESTIMATION OF AMINO ACIDS IN SOIL HYDROLYZATES BY THE MOORE AND STEIN METHOD. Soil Sci. 80: 181-188. 1955.

The Moore and Stein method for the nonbasic amino acids can be used satisfactorily for determination of these acids in soil hydrolyzates. It is not necessary to desalt the hydrolyzates, although if that were done, the columns would perhaps operate somewhat better.

Tamura, T., Jackson, M. L., and Sherman, G. D. MINERAL CONTENT OF A LATOSOLIC BROWN FOREST SOIL AND A HUMIC FERRUGINOUS LATOSOL OF HAWAII. Soil Sci. Soc. Amer. Proc. 19: 435-439. 1955.

Mineralogical analysis for two soils representing the Latosolic Brown Forest and Humic Ferruginous Latosol groups were made using X-ray, thermal, and chemical techniques. In the A horizon of the Latosolic Brown Forest soil geothite (28 percent) was the predominant mineral; in the B horizon gibbsite (42 percent) predominated. Other minerals included hematite (15-25 percent), magnetite (0-10 percent), quartz (5-10 percent), and layer silicates (15-20 percent) in the A and B horizons, respectively. In the A_2 horizon of the Humic Ferruginous Latosol from the island of Maui hematite (48 percent) was dominant; in the B horizon gibbsite (31 percent), hematite (25 percent), and amorphous alumino silicate (22 percent) were present in nearly equal quantities. In the C horizon of Humic Ferruginous Latosol the gibbsite content (48 percent) was substantially higher than the iron oxides (14 percent). The A_{22}, B, and C horizons of another Humic Ferruginous Latosol from the island of Kauai were also examined. The A_{22} horizon was predominantly hematite (45 percent) with appreciable anatase (15 percent) and ilmenite (15 percent). The B horizon contained both hematite (30 percent) and geothite (30 percent) as the dominant minerals; the C horizon contained kaolinite (35 percent) as the major mineral constituent.

Tanada, T. EFFECTS OF ULTRAVIOLET RADIATION AND CALCIUM AND THEIR INTERACTION ON SALT ABSORPTION BY EXCISED MUNG BEAN ROOTS. Plant Phys. 30: 221-225. 1955.

The effects of Ca, ultraviolet radiation, dilute HCl and NaCl solutions on salt absorption by excised mung bean roots (Phaseolus aureus) were investigated using Rb^{86} and P^{32} as tracers. Both Rb and phosphate uptake were greatly enhanced by the presence of Ca. Short-time studies indicated

that the locus of Ca action is on or near the outer surface of the cytoplasm. Short periods of pretreatment of excised roots with dilute HCl and NaCl solutions increased subsequent Rb uptake but decreased phosphate absorption. The effects of HCl and NaCl were reversed by Ca.

Rubidium absorption was increased by ultraviolet radiation of 2,537 Å, but the presence of Ca during absorption drastically decreased Rb uptake by irradiated roots. Phosphate absorption by irradiated roots was reduced by ultraviolet radiation to a slight degree, and was further decreased by the presence of Ca ions. Some of the absorption curves show a linear decrease of log ion uptake with ultraviolet dose.

The results obtained were interpreted as being due to the involvement of a ribonucleoprotein in salt absorption. The suggestion was made that the nucleic acid binds cations, while the protein moiety binds anions.

Tucker, T. C., and Kurtz, L. T. A COMPARISON OF SEVERAL CHEMICAL METHODS WITH THE BIO-ASSAY PROCEDURE FOR EXTRACTING ZINC FROM SOILS. Soil Sci. Soc. Amer. Proc. 19: 477-481. 1955.

A study was made to evaluate the forms of soil Zn removed by the Aspergillus niger bio-assay method and to compare several chemical procedures for extracting soil Zn. Soils used were from humid regions; only one was calcareous.

For 0.1N HCl, the effects of extraction time and ratio of soil to extracting solution were investigated. A ratio of 1:10 and a 45-minute shaking period were considered most satisfactory. Longer extraction periods and wider ratios resulted in removal of larger amounts of Zn, but the rate of Zn release diminished appreciably. The amount of soil Zn removed by 0.1N HCl during a 6-week extraction period, by successive extractions with 0.1N HCl, and the bio-assay values were about equal. This agreement suggests the existence of an acid soluble form which made up around one-fifth of the total soil Zn in the soils studied. Very little Zn was in the exchangeable form, and the organic form, if present, was apparently small.

Wahhab, A., and Uddin, F. INFLUENCE OF LIGHT ON INTERACTION OF AMMONIUM AND NITRITE IONS. Soil Sci. 80: 121-125. 1955.

Loss of elemental N due to reaction between NH_4 and NO_2 ions was studied in presence and absence of sunlight. Light had a profound influence on the loss of N due to the reaction between the two ions. Concentration of NH_4 ions increased the loss of N up to a certain maximum. Soil exerted no catalytic influence during photodenitrification. Increased loss of N in presence of soil was due to change in pH value of the medium due to addition of soil. Nitrogen losses increased as the pH value of the medium increased.

Wallace, A., Mueller, R. T., Lunt, O. R., Ashcroft, R. T. and Shannon, L. M. COMPARISONS OF FIVE CHELATING AGENTS IN SOILS, IN NUTRIENT SOLUTIONS, AND IN PLANT RESPONSES. Soil Sci. 80: 101-108. 1955.

Five Fe chelates were compared in laboratory and glasshouse tests. These included two relatively new agents that show much promise in correcting Fe chlorosis by soil application. The characteristics that make them promising are (a) greater stability in alkaline calcareous soils and in alkaline solutions than of other chelating agents, (b) absence of appreciable fixation (of one of them) on the clay fraction of the soil, and (c) relatively less toxicity (of one of them) than of the other chelating agents. The ability of EDTA, 138, and CDTA to extract Fe and Mn from the soil was determined. The Fe supplied to the plant by both of the new agents was available to plant processes. A procedure is given for determining Fe in presence of these chelating agents by orthophenanthroline making use of pH adjustments and heat.

White, E. M., and Riecken, F. F. BRUNIZEM GRAY BROWN PODZOLIC SOIL BIOSEQUENCES. Soil Sci. Soc. Amer. Proc. 19: 504-509. 1955.

A study was made of two biosequences composed of Brunizem and Gray Brown Podzolic soils and their forested intergrades to determine some of the properties of the intergrades and their relationship to recognized great soil groups. The morphology of the intergrade soils is intermediate to that of the associated Brunizems and Gray Brown Podzolic soils. Laboratory data indicate that, genetically, the intergrade soils are related more closely to the Gray Brown Podzolic soils than to the Brunizems.

Wiklander, L., and Elgabaly, M. M. RELATIVE UPTAKE OF ADSORBED MONOVALENT AND DIVALENT CATIONS AS EXCISED BARLEY ROOTS AS INFLUENCED BY THE EXCHANGE CAPACITY. Soil Sci. 80: 91-93. 1955.

The uptake of Na, Mg, and Ba by excised barley roots from Na-Mg- and Na-Ba-resin, -bentonite, and -kaolinite systems were studied. The results show that the uptake of divalent ions relative to that of monovalent ions increases with decreasing exchange capacities of the systems. This is a result of the intimate relationship between the exchange capacity and the unequal distribution of monovalent and divalent ions between the solid and solution phases. The results lend additional support to previous conclusions founded on the application of the Donnan equilibrium theory to the solid-plant system.

Woodruff, C. M. THE ENERGIES OF REPLACEMENT OF CALCIUM BY POTASSIUM IN SOILS. Soil Sci. Soc. Amer. Proc. 19: 167-171. 1955.

Energy of exchange is a measure of the intensity factor in the delivery of a balanced supply of nutrient cations from the exchange complex of the soil to the growing plant. Energies of exchange for the replacement of Ca by K in a soil may be computed from the cationic composition of water extracts from the soil. Cationic compositions of displaced soil solutions varied with the concentrations of soluble anions that in turn depended upon the moisture contents of the soils. But the variations were such that they reflected constant energies of exchange for each of the soils at different moisture contents. Energies of exchange for the replacement of Ca with K ranging from -3,500 to -4,000 calories were associated with K deficiencies in plants. Energies of exchange from -2,500 to -3,000 calories represented suitable balances between K and Ca. Energies of exchange of -2,000 calories or less were associated with excessive amounts of K in relation to the amounts of Ca that were present. The relationships between plant nutrition and energy of exchange appear to be universal in scope and applicable to all soils.

Soil Biology

Allos, H. F., and Bartholomew, W. V. EFFECT OF AVAILABLE NITROGEN ON SYMBIOTIC FIXATION. Soil Sci. Soc. Amer. Proc. 19: 182-184. 1955.

Nitrogen absorption from the atmosphere and from inorganic sources was measured and compared in a number of leguminous plants when varying quantities of inorganic N were applied. Inorganic N absorption, apart from the atmospheric N, was measured by the use of tagged fertilizer. The plants were grown in solution culture in exploded vermiculite for 10 weeks. Nitrogen fertilizer was added in small increments at weekly intervals.

The magnitude of N fixation was proportional to the total growth and N uptake. Nitrogen fixation decreased and fertilizer absorption increased with increase in the quantity of available N. In no instance, however, was fixation completely inhibited or was all of the available N absorbed by the legume plant. The lower rates of addition of inorganic N served to increase growth and N absorption more than they served to diminish fixation. High increments of N fertilizer had less influence than the low increments in increasing plant growth but a greater tendency to replace the fixation process.

Blue, W. B., Eno, C. F., and Westgate, P. J. INFLUENCE OF SOIL PROFILE CHARACTERISTICS AND NUTRIENT CONCENTRATIONS ON FUNGI AND BACTERIA IN LEON FINE SAND. Soil Sci. 80: 303-308. 1955.

Leon fine sand which had been in vegetable production for 50 years was used in this study. An underground irrigation and drainage system maintained the water table at the desired depth. The upper part of the A_2 horizon (9- to 12-inch depth), with low organic-matter content and exchange capacity, had smaller quantities of nutrients and fewer microorganisms than did other parts of the profile. In this layer, nutrient concentrations and numbers of microorganisms increased very little with increasing applications of fertilizer. Exchange capacity and nutrient concentrations were higher in the 12- to 30-inch zone than in the 9- to 12-inch layer. Nutrient concentrations in the 12- to 30-inch portion of the profile increased with rates of fertilization.

Bruch, C. W., and Allen, O. N. DESCRIPTION OF TWO BACTERIOPHAGES ACTIVE AGAINST Lotus RHIZOBIA. Soil Sci. Soc. Amer. Proc. 19: 175-179. 1955.

The isolation and proliferation of four races of phage against rhizobia from nodules of Lotus corniculatus are described. Growth characteristics of two races, P2 and P-11, are given in detail. Neither of these two phages showed differences in plaque morphology. Higher titers of these races were not obtained in media containing increased increments of yeast water and Ca as compared with modified medium 79. Optimum pH level for phage proliferation and viability ranged between pH 6.5 and 7.5. Each phage maintained its titer for 60 days upon storage at 2° C., but was increasingly less stable at 10° C., 25° C., and 37° C. Optimum temperature for proliferation was 27 to 30° C.; inactivation was rapid at 45° C., 50° C., and 55° C. Alterations in infectiveness and effectiveness, as judged by host plant response, were not obtained when (a) phage-resistant strains and (b) suspensions of phage particles and susceptible rhizobia (ratio 3:1) were used as inocula in greenhouse tests.

Downs, S. C., McCalla, T. M., and Haskins, F. A. STACHYBOTRYS ATRA, AN EFFECTIVE AGGREGATOR OF PEORIAN LOESS. Soil Sci. Soc. Amer. Proc. 19: 179-181. 1955.

Twelve cellulose-decomposing fungi were tested for aggregating ability with Peorian loess containing ground straw at a concentration of 1 percent. Of the 12 fungi, Stachybotrys atra was the most effective soil aggregator. Under labora-

tory conditions used, it produced from 2 to 30 times more aggregation than any of the other fungi tested.

Studies were made of the influence of various environmental factors on the degree of aggregation effected by S. atra. An incubation time of 1 week was sufficient for a relatively high degree of aggregation. In comparison, longer periods resulted in only slightly improved aggregation. Varying temperature between 20° and 28° C. had no appreciable effect on the aggregation by S. atra. Approximately equivalent aggregations were attained at the moisture levels of 20, 25, and 30 percent, which were definitely superior to the 10- and 15-percent levels. Alfalfa and straw, either separately or as a mixture, were satisfactory sources of energy material for S. atra. The aggregation obtained with alfalfa, however, was somewhat higher than that obtained with straw.

Kirkham, D., and Bartholomew, W. V. EQUATIONS FOR FOLLOWING NUTRIENT TRANSFORMATIONS IN SOIL, UTILIZING TRACER DATA: II. Soil Sci. Soc. Amer. Proc. 19: 189-192. 1955.

Theoretical equations are derived for calculating mobilization and immobilization rates, from observable data, in a tagged atom system of available and unavailable (mobile and immobile) plant nutrients undergoing simultaneous interchange in soil. The equations are needed since the rates, at least by present methods, cannot be measured directly. The theory is more general than that developed by the authors previously, no restrictions now being placed on the relative amounts of the available and unavailable material. Two cases are considered: (1) the mobilization rate m and the immobilization rate i are constant; (2) m is proportional to the amount of unavailable material and i is proportional to the amount of available material, the assumption in case 2 being that of mass action. Certain experimental data are analyzed, and for these data, the theory for case 2 is in good agreement with the experiments. The theory for case 1 should be applicable in some other instances, especially if the time intervals in question are small.

Schwartz, S.M., and Martin, W. P. INFLUENCE OF SOIL ORGANIC ACIDS ON SOLUBLE PHOSPHORUS IN MIAMI AND WOOSTER SILT LOAM SOILS. Soil Sci. Soc. Amer. Proc. 19: 185-188. 1955.

The purpose of these experiments was to determine whether or not there was a correlation between P solubility and organic acid occurrence. Field samples from 2-year rotation plots were also periodically analyzed for soluble P and organic acids through a 10-week period. The organic acids separated from soils treated with either alfalfa or wheat straw plus N were apparently identical with those in the control samples.

Phosphate levels increased in the alfalfa-treated and control samples after 4 weeks of aerobic incubation as did isocitric and possibly tartaric acids. However, correlation between these acids and P solubility in the wheat straw plus N-treated samples was apparently lacking. A similar lack of correlation was apparent under anaerobic conditions. Further, the field samples contained no significant amounts of isocitric acid. The incorporation of sweetclover green manure appeared to have no influence either on the amounts or distribution of the several organic acids recovered from plots without green-manure crop.

Van Eseltine, W. P. OCCURRENCE OF AZOTOBACTER IN CERTAIN WESTERN SOUTH CAROLINA SOILS. Soil Sci. 81: 29-32. 1956.

It was concluded that (a) the elective culture method using a modified Ashby's medium is satisfactory for detecting Azotobacter in these soils; (b) the Azotobacter are widely distributed, though perhaps not numerous, in the soils of western South Carolina; and (c) by materially increasing the number of samples tested, the methods used in this study can be made to yield information of value concerning the effect upon Azotobacter numbers of such factors as seasons of year, soil type, soil pH, and abundance of certain mineral elements in the soil.

Soil-Plant-Animal Relationships

Anderson, J. U. CHARACTERIZATION OF SOME HALOMORPHIC SOILS AND THEIR NORMAL ASSOCIATES IN THE YAKIMA VALLEY. Soil Sci. Soc. Amer. Proc. 19: 328-333. 1955.

A study was made of four soils--Naches, a Brown soil; Fiander, a Solonetz soil; and Umapine and Ahtanum, Solonchak soils. These occur in close association in the Yakima River Valley of south central Washington in poorly defined zones which parallel the lower edge of the alluvial fan on which the soils are found. Areas of pure soil types are extremely small. Studies made of transects across soil boundaries indicate that materials from which these soils were formed were heterogeneous, and that soil morphology has been greatly influenced by parent-material differences.

Resalinization has occurred to varying degrees since the beginning of irrigation in the Yakima Valley. The concentrations of soluble and exchangeable cations in the soils vary not only between series but also within a series, chiefly as a function of positions on the alluvial fan.

Anderson, K. L., and Fly, C. L. VEGETATION-SOIL RELATIONSHIP IN FLINT HILLS BLUESTEM PASTURE. Range Mgt. Jour. 8: 163-169. 1955.

To facilitate studies of vegetation in experimental bluestem pastures and to aid in the eval-

uation of species populations and trends that result from management treatments, soils of the experimental bluestem pastures of the Kansas Agricultural Experiment Station were mapped, delineating 13 upland soil-mapping units on the basis of slope, degree of erosion, and soil conditions. This number was reduced to 10 by combining certain similar ones.

Sampling of the plant populations by means of randomized line-transect samples revealed that the number of distinctive vegetational units was smaller than the number of soil units mapped. Statistical analyses of the populations of major forage site differences have been the basis for recognizing six range sites, one of which was not sampled in these studies.

Comparison of the study area with the Flint Hills grasslands as a whole reveals that it is representative of the region and conclusions drawn from the study should have widespread application. A groundwork has been laid for classification of Flint Hills rangelands and land use for research.

Arneman, H. R., and McMiller, P. R. THE PHYSICAL AND MINERALOGICAL PROPERTIES OF RELATED MINNESOTA PRAIRIE SOILS. Soil Sci. Soc. Amer. Proc. 19: 348-351. 1955.

The morphological, chemical, and mineralogical characteristics of soil are to a considerable extent attributable to the amount of water that enters the soil. The Clarion, Nicollet, and Webster soils in south central Minnesota were investigated. These soils are members of a catena developed on calcareous glacial till of Wisconsin age (Mankato substage).

Three profiles of each series from widely scattered areas were studied. The study revealed that the (1) color of the soil is directly related to drainage; (2) there was little or no accumulation of clay in the B horizons of any of the soils; (3) the surface soil of the Clarion series is the most highly weathered horizon as indicated by a relatively low content of apatite and orthoclase, a high content of garnet, and the presence of kaolinite in the course clay fraction; (4) the high cation exchange capacity of all soils is not attributed entirely to organic matter but more particularly to the high montmorillonite content of the clay fraction; and (5) the observable and distinguishable properties of the soils of the three series are chiefly morphological rather than chemical or mineralogical.

Caldwell, A. C., Farnham, R. S., and Hammers, F. L. A CHEMICAL AND MINERALOGICAL STUDY OF CLAY MATERIALS FROM SEVERAL GRAY-BROWN PODZOLIC SOILS OF MINNESOTA. Soil Sci. Soc. Amer. Proc. 19: 351-354. 1955.

Soil samples were collected from two Fayette soils developed from Peorian loess, one Milaca formed from noncalcareous glacial till of Cary substage of the Wisconsin, and one Hayden soil developed from calcareous glacial till of Mankato substage of the Wisconsin. Morphological observations placed these soils in the Gray-Brown Podzolic group. Mechanical analysis showed these soils to be silt loams. Some accumulation of clay in the B_2 horizon substantiated field observations of some podzolization having occurred.

The clay material less than 0.5μ in size was separated from the A_1, A_2, B_1, B_2, and C horizons of these profiles. Total chemical analysis of the clay fraction showed little differentiation in content of inorganic constituents within and between profiles. X-ray diffraction and differential thermal analysis of some of the clays indicated clay minerals largely of the montmorillonite type. Relatively high total exchange capacities of the clays were indicative also of montmorillonitic types of clay minerals.

Galloway, H. M., Gray, F., and Murphy, H. F. SOILS OF WAGONER COUNTY, OKLA. Okla. Agr. Expt. Sta. Misc. Pub. MP-42. 1955.

This map and report delineates and describes the naturally occurring associations of soils in Wagoner County, Okla. It is designed to furnish background for the study and understanding of these soils. The degree of detail shown furnishes information sufficient to aid in development of agricultural programs.

Gile, L. H., Jr. THE GENESIS AND PROPERTIES OF SOME COLLUVIAL (LOCAL ALLUVIAL) SOILS IN THE DRUMLIN LANDSCAPE OF DODGE COUNTY, WISCONSIN. Soil Sci. Soc. Amer. Proc. 19: 229-232. 1955.

Field and laboratory data are presented for three Miami profiles, one undisturbed and two eroded, and two related colluvial soil profiles. The eroded soils were higher in exchangeable K, available P, and pH than were the associated colluvial soils. Where erosion was moderate, the organic-matter content was higher in the colluvial topsoil than in the cultivated upland topsoil. Where erosion was severe, the opposite was true. An organic-matter content of over 2 percent was found in a cultivated surface horizon composed largely of C-horizon material.

Hanna, R. M., and Bidwell, O. W. THE RELATION OF CERTAIN LOESSIAL SOILS OF NORTHEASTERN KANSAS TO THE TEXTURE OF THE UNDERLYING LOESS. Soil Sci. Amer. Proc. 19: 354-359. 1955.

Particle-size analyses were made on 10 profiles representing 4 soil series. The profiles were located on a traverse perpendicular to the Missouri River from the Missouri River bluffs in northwestern Doniphan County, Kans., to a point in southwestern Brown County, 24 miles from the

river. The first sampling site was located 2 miles from the Missouri River. Subsequent sites were located at about 2-1/2-mile intervals. The thickness of the loess, as measured at most sites, decreased from about 100 feet at the river bluffs to 6 feet at the tenth site. The textural composition and pH of each horizon were determined in the laboratory. The texture of the C, B, and A horizons was observed to become finer with increased distance from the river up to 16 miles from the bluff. Beyond that point there was little if any decrease in particle size with distance. The change in texture of the C horizon with distance from the river appears to be the dominant factor in the development of the four soil series, Monona, Marshall, Sharpsburg, and Grundy, which have not been finally correlated in this area. This work further substantiates the belief that the Missouri River Valley flood plain was a source of some of the loessial deposits of northeastern Kansas.

Hold, R. F., and McMiller, P. R. CHARACTERISTICS OF SOME FOREST SOILS FROM THE GRAY-BROWN PODZOLIC-PODZOL TRANSITION ZONE IN NORTHEASTERN MINNESOTA. Soil Sci. Soc. Proc. 20: 84-87. 1956.

Gray-Brown Podzolic soils grade into the Podzols in a relatively narrow belt of soils in Northeastern Minnesota. This paper presents the properties of soils found in this narrow transition zone.

Podzols and Brown Podzolic soils predominate in the northern part of this zone and Gray-Brown Podzolic soils predominate to the south. In the narrow belt under consideration there is an intermingling of podzols, Brown Podzolic, Gray-Brown Podzolic, and Gray Wooded soils. Influence of climatic and biotic factors on an interlacing of parent materials from several different glacial drifts has given rise to some rather distinctive profile differentiations in this zone.

Kunze, G. W., and Templin, E. H. HOUSTON BLACK CLAY, THE TYPE GRUMUSOL: II. MINERALOGICAL AND CHEMICAL CHARACTERIZATION. Soil Sci. Soc. Proc. 20: 91-96. 1956.

The following analyses are reported on each of the several horizons of five profiles of typical Houston Black Clay from widely separated sites in Texas described in Part I: particle size distribution, organic matter, Ca-carbonate equivalent, exchange capacity, ethylene glycol retention, and pH. In addition X-ray diffraction analyses are reported for the following fractions: silt (0.05 to 0.002 mm.), bulk clay ($< 2\mu$), coarse clay (2μ to 0.2μ), and fine clay ($< 0.2\mu$). Differential thermal analyses are presented for the $<0.2\mu$ fraction.

The average clay ($< 2\mu$) content for the five profiles varies between the narrow range of 57.7 and 60.8 percent Fine clay ($< 0.2\mu$) made up as much as 84 percent of the total clay fraction. The Ca-carbonate equivalent ranged from a minimum of 5.4 percent to a maximum of 70.2 percent. Zones of Ca-carbonate enrichment resulting from leaching were not found. Organic matter in the surface horizons (0 to 18 inches) from virgin sites ranged from 3.06 to 8.34 percent. The silt fractions are very largely quartz and calcite. Quartz predominated in the silt fraction from surface horizons, while calcite increased with depth and in three profiles assumed the dominating role in the C horizon. Montmorillonite strongly predominated the clay fraction ($< 2\mu$) and based upon X-ray diffraction and exchange capacity studies it occurs in essentially a pure state in the $<0.2\mu$ fraction of three profiles. The exchange capacities for the A_{1-1} horizons averaged 64 me. while the average for the C_2 horizons was 40 me.

Matthews, B. C., Reid, R. F., and Olding, A. B. GENESIS AND MORPHOLOGY OF THE ONEIDA AND HALDIMAND SERIES--GREY-BROWN PODZOLIC SOILS IN ONTARIO. Canad. Jour. Agr. Sci. 35: 500-510. 1955.

The pH, bulk density, organic-matter content, cation exchange capacity, and exchangeable cations of genetic horizons of 4 Oneida profiles and 3 Haldimand profiles were similar. The clay content of the B and C horizons in the Haldimand soils was much higher than in comparable horizons in the Oneida soils although the texture of the A horizons was similar in all soils. Chemical analysis of the whole soils and of the 0.25 to 1 mm. sand fraction showed that the Haldimand soils were developed partially from stone-free overwash and partially from much finer clay or till. The Oneida soils were developed from a uniform till deposit.

Matzek, B. L. MOVEMENT OF SOLUBLE SALTS IN DEVELOPMENT OF CHERNOZEMS AND ASSOCIATED SOILS. Soil Sci. Soc. Amer. Proc. 19: 225-229. 1955.

In the formation of Chernozem, Chestnut, and associated soils in northwestern North Dakota, translocation of carbonates and other soluble salts takes place. Salts are removed completely from the uppermost 15 to 36 inches of the Chernozem and Chestnut profiles formed from medium-textured till with initial contents of 0.13 to 0.41 percent. Maximum accumulations of soluble salts may be at depths between 48 and 108 inches, but may also occur at greater depths such as between 78 and 132 inches. Accumulations of Ca carbonate are nearer the surface than are the accumulations of other soluble salts.

Nyun, M. A., and McCaleb, S. B. THE REDDISH BROWN LATERITIC SOILS OF THE NORTH CAROLINA PIEDMONT REGION: DAVIDSON AND HIWASSEE SERIES. Soil Sci. 80: 27-41. 1955.

The chemical, physical, mineralogical, and morphological properties of 4 profiles of the Davidson series and 1 profile of the Hiwassee

series indicate that the Reddish Brown Lateritic soils in North Carolina may have been mildly podzolized and exhibit some of the properties of the Red-Yellow Podzolic soils.

Mineralogically these profiles show almost complete loss of the ferromagnesian and feldspar minerals, the alteration products being dominantly kaolinite and halloysite. Iron oxide minerals, primary and secondary, accumulate with maximum concentrations in the B_2 horizons. The alteration of biotite through successive stages of kaolinite is suggested as the mechanism of clay synthesis from biotite. Conversion of the pyroxenes and amphiboles to kaolinite was not elucidated because of sampling difficulties in these deeply weathered soils.

Rich, C. I., and Obenshain, S. S. CHEMICAL AND CLAY MINERAL PROPERTIES OF A RED-YELLOW PODZOLIC SOIL DERIVED FROM MUSCOVITE SCHIST. Soil Sci. Soc. Amer. Proc. 19: 334-339. 1955.

A study was made of a Red-Yellow Podzolic soil with particular regard to the properties of dioctahedral vermiculite, one of its major clay minerals. The soil, Nason silt loam, which is derived from a muscovite schist residuum, was nearly devoid of exchangeable Ca and low in other bases. Although the cation exchange capacity of the B_3 horizon was 25 me. per 100 gm. soil, this horizon contained only 0.08 me. Ca per 100 gm. Clay minerals present were kaolinite, dioctahedral vermiculite, and regularly and randomly interstratified illite-vermiculite. The 14.7A basal spacing of vermiculite from the C_1 horizon moved to 10.5A when the clay was K saturated, but the effectiveness of K saturation decreased from the C_1 horizon through the A horizon where there was only slight collapse. Boiling the clay from the B_1 horizon for 102 hours in 1N KCl caused a change of the 14.7A basal spacing to only 14.2A. However, treatment of the clay in 1N KCl plus 0.1 N HCl or treatment with 1N NH_4F altered this spacing to near 10A. The difficult collapsed mineral had a high internal surface, high base exchange capacity, and low divalent cation content. Easily collapsed dioctahedral vermiculite was made difficultly collapsed by repeated Al saturation and drying. Heat treatment at 800°C. collapsed the 14.7A spacing of the mineral in all horizons to 10.3A. Glycerol solvation caused no increase of the 14.7A spacing. These results together with DTA data support the theory that nonexchangeable Al in the interlayer position in vermiculite restricts collapse of the mineral on K saturation.

Ruhe, R. V., Prill, R. C., and Riecken, F. F. PROFILE CHARACTERISTICS OF SOME LOESS-DERIVED SOILS AND SOIL AERATION. Soil Sci. Soc. Amer. Proc. 19: 345-347. 1955.

Inferences are made in evaluating soil drainage conditions from morphological characteristics of soils, such as mottles and deoxidized zones. These characteristics are not infallible criteria for indicating drainage conditions, and an evaluation of local and regional relationships is often necessary for a proper interpretation. An excellent example of the need for such an evaluation is afforded by a study of weathering zones in Wisconsin loess in southwestern Iowa. A repeated occurrence in regional distribution of two deoxidized zones, the upper one surmounted by an abundantly mottled zone, was observed in the Wisconsin loess. The present positions of these deoxidized zones are moderately well or well drained, indicating that they are not related genetically to the present environment but are relict from a pre-existing environment of poorer drainage. Well-drained soils occurring on the modern landscape frequently are mottled in the B and C horizons. This mottling in the profiles is interpreted as an incidental morphological characteristic and not related genetically to the profile development, but inherited from a pre-existing environment of poorer drainage.

Schiff, L. THE STATUS OF WATER SPREADING FOR GROUND-WATER REPLENISHMENT. Amer. Geophys. Union Trans. 36: 1009-1020. 1955.

Methods of spreading water on land surfaces and by injection are reviewed and some results given. Some localities utilizing or contemplating the use of water spreading to replenish groundwater supplies are mentioned. Included are: (1) developments in vegetative, chemical, and mechanical treatments to increase infiltration rate; (2) shaft, trench, and pit injection methods which cut through less pervious soil and inject water into aquifers; and (3) operational procedures such as cultural methods, length of wetting and drying periods, and surface head. Soil-water movements are described and interpreted in the light of the Darcy equation. Limitations in the use of treatments based on the surface soil and stratigraphy are described.

Stackhouse, C. H., Bailey, W. R., Allaway, W. H., Hockensmith, R. D., and Zimmerman, G. K. LAND CLASSIFICATION AS A GUIDE IN PRODUCTION ADJUSTMENT PROGRAMS. Jour. Soil and Water Conserv., Vol. 10, No. 4. July 1955.

Ideally, wise land use and production adjustment should be not only compatible, but mutually complementary. Actions farmers take from year to year toward better use of resources should be of aid, simultaneously, in desirable diversification and adjustment of crop production. Similarly, production adjustments should be made in such a way as to provide the best possible protection and efficient use of natural resources.

Present practice falls considerably short of the ideal, but as a Nation we are making progress in the right direction. As is so often the case, one of the major needs in support of this trend is ad-

ditional knowledge. Specifically, there is need for much more acre-by-acre knowledge about the use-capabilities of America's farmlands. There is need, too, for more proficient use of the land capability information already available.

Swanson, C. L. W. AERIAL PHOTOGRAPHY REQUIREMENTS FOR SOIL SURVEY FIELD OPERATIONS. Photogrammetric Engin., pp. 709-711. 1954.

This paper gives the major results of a study of technical requirements for aerial photography suitable for soil survey field operations which was made by the National Soil and Fertilizer Research Committee. The study was based on a questionnaire, circulated to organizations concerned with surveys in all States and Territories of the United States. A partial summary of the questionnaire returns is given.

Tedrow, J. C. F., and Hill, D. E. ARCTIC BROWN SOIL. Soil Sci. 80: 265-275. 1955.

In numerous places in the Arctic regions where permafrost is deep, a well-drained soil with a distinct brown-colored solum is commonly present. This soil has been tentatively designated Arctic brown. Soil structure is rather obscure, bur fine crumb is evident in the solum except where there is a large proportion of coarse sand and gravel. Here single-grain structure is evident. Laboratory data show that clay accumulates in moderate amounts in the surface layers. The surface layers are moderately to strongly acid, with increasing pH values at greater depths. Organic matter decreases with depth. The clay composition consists of nearly equal quantities of hydrous micus and kaolinite. Reconnaissance investigations in about 15 scattered locations in the Alaska Arctic slope indicate that this soil is found in less than 1 percent of the total area.

Templin, E.H. Mowery, I. C., and Kunze, G. W. HOUSTON BLACK CLAY, THE TYPE GRUMUSOL: I. FIELD MORPHOLOGY AND GEOGRAPHY. Soil Sci. Soc. Proc. 20: 80-90. 1956.

In most characteristic form the profile of Houston Black clay (the type specimen of the new group of Grumusols as proposed by Oakes and Thorp) consists of (1) a very thick, much darkened, uneluviated A horizon of black calcareous clay 2 to 4 feet thick, (2) a slightly darkened transition several feet thick, and (3) substratum of marine clay or marl. Thickness of the black layer ranges between 1/2 and 5 feet with position in the original pit-and-mound gilgai microrelief. All parts of the solum are equally clayey and, where exposed to thorough drying and moistening without confinement of volume, naturally crumble to a mulch of discrete grains. Volume change on moistening, plasticity, and stickiness approximate the maximum that occurs in soil. Free carbonates are present but lowest in the upper few feet, intermediate in total amount but partially segregated into concretions between depths of about 3 and 8 feet, highest in the relatively unaltered substrata.

This soil type, with an aggregate area of some 2-1/2 million acres, is the most extensive of its kind in the United States and exemplifies the blackest, most plastic, and more crumbly (self mulching) variety of neutral to calcareous dark clay soils high in montmorillonite. Developed under prairie vegetation on smooth erosional upland in moist-subhumid parts of the Gulf Coastal Plain, its occurrence is confined to outcrops of argillaceous limey rocks and related to a climate that gives alternating moistening and desiccation of the profile to depths of as much as 10 feet. Relations to some of the important closely related soil series are given. Total extent of such dark clays in the United States is a minor fraction of that in some tropical countries.

Veihmeyer, F. J., and Hendrickson, A. H. DOES TRANSPIRATION DECREASE AS THE SOIL MOISTURE DECREASES? Trans. Amer. Geophys. Union 36: 425-428. 1955.

This paper gives results obtained from a prune tree and from a pine tree grown in a suspended tank that permitted a continuous record of moisture loss from the soil. Additional results from field trials with pine, oak, and manzanita on a watershed area and from apricot and prune trees under cultivation show that the rate of moisture extraction from the soil is not influenced by the water in the soil so long as the latter is above the permanent wilting percentage.

Wright, J. R., Levick, R., and Atkinson, H. J. TRACE ELEMENT DISTRIBUTION IN VIRGIN PROFILES REPRESENTING FOUR GREAT SOIL GROUPS. Soil Sci. Soc. Amer. Proc. 19: 340-344. 1955.

This investigation was a study of the distribution and comparative leaching of several trace elements in virgin profiles of the Podzol, Brown Podzolic, Gray-Brown Podzolic, and Brown Forest great soil groups. Two profiles of each group were analyzed for total Zn, Pb, Cu, Co, Mn, and Mo.

The results were compared with those for sesquioxides. The distribution of trace elements was more varied in Podzol and Brown Podzolic than in Gray-Brown Podzolic and Brown Forest profiles.

Lead showed the greatest proportional accumulation, and this was most pronounced in the A_0 horizons of Podzol and Brown Podzolic profiles. Relative to sesquioxides, Zn accumulated in the A_0 and B horizons of Podzol and Brown Podzolic soils and in the A_1 horizons of Brown Forest profiles. Accumulations of Cu relative to sesquioxides occurred mainly in the A_0 horizons of Podzol and Brown Podzolic profiles. Considering all soils, Cu was the element most susceptible

to leaching. The distribution of Co paralleled that of sesquioxides in Gray-Brown Podzolic and Brown Forest profiles. The profile distribution of Mn was irregular. The Mo content was greatest in the B horizon of all profiles. Generally, the sola accumulated Mo relative to sesquioxides.

HYDROLOGY

General

Blaney, H. F. EVAPORATION FROM AND STABILIZATION OF SALTON SEA WATER SURFACE. Amer. Geophys. Union Trans. 36: 633-640. 1955.

Salton Sea was formed as the result of a break of the Colorado River in 1905 when practically the entire flow of the river discharged into the Salton Basin for nearly 2 years. At that time this body of water covered about 350,000 acres and reached a maximum elevation of 195 feet below sea level. For many years the excess of evaporation over inflow caused the elevation of the water surface to drop some 55 feet to minus 250 feet by 1923. Since 1935, the water level in Salton Sea has been rising. In recent years, this has resulted in encroachment and damage on adjoining lands, causing concern to Federal, State, and local agencies and landowners. Therefore, three evaporation stations bordering the sea were established to study the problem. An analysis of pan evaporation, gage heights, and inflow measurements indicates that the annual evaporation from Salton Sea ranges from about 70 to 76 inches. The Federal Government has withdrawn from entry all public land in the area below the elevation minus 220 feet. Salton Sea, in January 1954, had risen to an elevation of minus 235.8 feet and thus has leeway of 15.8 feet before reaching the minus 220-feet contour. A review of this study and other reports indicates that the water surface will continue to rise for a number of years but will eventually stabilize below an elevation of minus 220 feet prior to the year 1980.

Boreli, M. FREE-SURFACE FLOW TOWARD PARTIALLY PENETRATING WELLS. Amer. Geophys. Union Trans. 36: 664-672. 1955.

By means of the relaxation technique, both the form of the free surface and the characteristics of flow have been determined for a systematically selected series of wells that partially penetrate a homogeneous aquifer. The computed rates of discharge are compared with rates indicated by existing formulas, such as those of Kozeny and Forchheimer, the errors of which are sometimes quite large. An improved formula is presented.

Cushman, R. L., and Halpenny, L. C. EFFECT OF WESTERN DROUGHT ON THE WATER RESOURCES OF SAFFORD VALLEY, ARIZONA, 1940-1952. Amer. Geophys. Union Trans. Vol. 36, No. 1, 1955.

Records of precipitation, runoff in the Gila River, ground-water withdrawals for irrigation, and changes in ground-water level in Safford Valley, Arizona, provide a basis for noting the effect of wet and dry periods on the hydrologic cycle. An unusually wet period, 1940-41, was followed by a period of drought, 1942-52. The irrigable area is limited by natural causes, the area irrigated with surface water is effectively limited by court decree, and less than 1,000 acres are irrigated exclusively from wells. Thus relatively little expansion in this irrigated area has occurred during the period concerned to obscure the climatic effects, although cultivation has been more intensive in recent years and the water demand has been correspondingly larger. The wet period of above-normal streamflow and ground-water levels provided a cushion that delayed and reduced the effects of the drought. As the groundwater storage in the valley is relatively small, however, withdrawals of ground water as a supplemental supply for irrigation eventually lowered water levels sufficiently to reduce well yields. The concentration of dissolved mineral matter increased in the remaining ground water,. making it less desirable for irrigation use than previously.

Glover, R. E. A NEW METHOD FOR PREDICTING TRANSIENT STATES OF SALINITY INTRUSION INTO THE SACRAMENTO-SAN JOAQUIN DELTA. Amer. Geophys. Union Trans. 36: 641-648. 1955.

The mechanism by which the tidal changes propagate salinity into the Delta channels and the manner in which this propagation is opposed by the fresh water streams flows are expressed in mathematical form. Solutions of the basic differential equation are given which are suitable for computation is described. As an example of the use of these methods they are applied to the historical records to determine a depletion curve for the Delta by using the observed salinities as an indicator and finding the flows out of the Delta which were necessary to hold the salinities to the observed amounts. While the primary usefulness of this depletion curve is to form a basis for further estimates of ocean salinity encroachment, it is compared to use curves derived from independent sources.

Hantush, M.S., and Jacob, C.E. NON-STEADY RADIAL FLOW IN AN INFINITE LEAKY AQUIFER. Amer. Geophys. Union Trans. 36: 95-100. 1955.

The nonsteady drawdown distribution near a well discharging from an infinite leaky aquifer is

presented. Variation of drawdown with time and distance caused by a well of constant discharge in confined sand of uniform thickness and uniform permeability is obtained. The discharge is supplied by the reduction of storage through expansion of the water and the concomitant compression of the sand, and also by leakage through the confining bed. The leakage is assumed to be at a rate proportional to the drawdown at any point. Storage of water in the confining bed is neglected. Two forms of the solution are developed. One is suitable for computation for large values of time and the other suitable for small values of time. This solution is compared with earlier solutions for slightly different boundary conditions.

Hantush, M. S., and Jacob, C. E. NON-STEADY GREEN'S FUNCTIONS FOR AN INFINITE STRIP OF LEAKY AQUIFER. Amer. Geophys. Union Trans. 36: 101-112. 1955.

Solutions are obtained for the nonsteady flow to a well in an infinite-strip of leaky aquifer whose boundaries are maintained either at a constant head or at a vanishing flux. These solutions are used to deduce the corresponding solutions for nonleaky aquifers. Also they are used to obtain the nonsteady Green's functions for the infinite-strips. Green's functions are tabulated for infinite quadrants and half-planes.

Hartman, M. A., and Wilke, R. W. DOWNSTREAM EFFECTS OF UPSTREAM FLOODWATER-RETARDING STRUCTURES. Jour. Soil and Water Conserv. 10: 219-22. 1955.

This article summarizes a study made by the Department of Agriculture to forecast the probable effects of a system of upstream floodwater-retarding structures on downstream flood flows. Hydrographs of four representative floods with and without the structures are compared to show the computed effect on flood flows of these structures on the Verdigris River watershed above Coybille, Kans.

Effectiveness of the structures increases with storm magnitude from a minimum of no effect on a flood small enough to pass unimpeded through the structure outlets, to a maximum of about 55 percent on the largest flood which could be controlled without emergency spillway discharge. The effectiveness is decreased on floods which exceed the storage capacity of the reservoir pool.

Hosler, C. L., and Hosler, C. R. AN INVESTIGATION OF THE FREEZING OF WATER IN CAPILLARIES. Amer. Geophys. Union Trans. 36: 126-132. 1955.

In order to isolate the factors governing the freezing point of cloud and precipitation elements, experiments have been made to measure the effects of physical dimension and of certain ions in solution upon the freezing temperature of water in glass capillaries. The results of these experiments indicate that the freezing point of water in capillaries is independent of the volume or of the interface area, and that the radius of the capillary tubing is the only physical dimension that affects the freezing point of water contained in it. The amount of supercooling necessary to induce freezing can be either increased or diminished by the addition of certain ions in solution. The magnitude and sign of the change in freezing point are functions of the type of ions in solution, the molar concentration of the ions, and the capillary radius.

Hutchins, W. A. THE NEW MEXICO LAW OF WATER RIGHTS. Tech. Report No. 4: 1-61. 1955.

This statement of the New Mexico law of water rights was prepared as part of the revision of "Selected Problems in the Law of Water Rights in the West," which was issued in 1942 as Miscellaneous Publication 418 of the United States Department of Agriculture.

Hutchins, W. A. A COMPARISON OF RIPARIAN AND APPROPRIATIVE RIGHTS. Meeting of Southwestern Social Science Ass'n., Dallas, Tex. April 8-9, 1955.

Riparian and appropriative rights are rights to the use of water. They are accorded by different systems of water law known, respectively, as the riparian doctrine and the appropriation doctrine. In some States both doctrines are recognized concurrently with respect to the water of watercourses; in other States, only the riparian doctrine is recognized; and in still others, the appropriation doctrine only. The United States Supreme Court has taken the position that each State is free to accept or to reject either system of water law.

Appropriative rights in some States may attach to percolating ground waters. In some, rights analogous to riparian rights exist in lands that overlie percolating waters. This discussion, however, is confined to riparian and appropriative rights in watercourses. A watercourse, in the eyes of the law, comprises a definite natural stream flowing in a definite natural channel and originating from a definite source or sources of supply.

Love, L. D. THE EFFECT ON STREAM FLOW OF THE KILLING OF SPRUCE AND PINE BY THE ENGELMANN SPRUCE BEETLE. Amer. Geophys. Union Trans. 36: 113-118. 1955.

An outbreak of the Engelmann spruce beetle on the White River Plateau of Western Colorado killed the Engelmann spruce and lodgepole pine on a considerable portion of the 762-sq. mi. drainage basin of White River above the town of Meeker, Colo. Statistical analyses were made to compare streamflow and water content of snow for White River with similar measurements made for the 206-sq. mi. drainage basin of Elk River above Clark, Colo. The analyses show that the flow of

White River increased after the beetle outbreak, and this increase is attributed to reduced interception of snow and to reduced transpiration by the beetle-killed trees. Total annual streamflow of White River was compared for three periods: (1) the 1937-40 water years before the killing of the spruce and pine; (2) the 1941-46 water years during which the beetle outbreak was most active; and (3) the 1947-51 water years after the killing of the mature and overmature spruce and pine had been completed. The average annual streamflow increased by 1.22 inches during 1941-46 and by 2.28 inches during 1947-51 as compared to 1937-40 after adjustment was made for climatic fluctuations.

Peele, T. C., and Beale, O. W. LABORATORY DETERMINATION OF INFILTRATION RATES OF DISTURBED SOIL SAMPLES. Soil Sci. Soc. Amer. Proc. 19: 429-432. 1955.

A procedure for determining infiltration rates of disturbed soil samples in the laboratory, using simulated rainfall, is described. Data showing the relation of laboratory infiltration rates to those measured on cultivated areas in the field are presented. Comparisons of runoff from natural storms with infiltration rates determined in the laboratory and the field are given for several soil types. The laboratory infiltrometer, the type-F field infiltrometer, and infiltration during natural storms placed the different soils in the same order. The usefulness of the laboratory infiltrometer for evaluating the effects of rotations, chemical soil conditioners, and inherent soil properties on infiltration in the surface soil of clean-cultivated areas is briefly discussed.

Penman, H. L. ESTIMATING EVAPORATION. Amer. Geophys. Union Trans. 37: 43-50. 1956.

Evaporation is a physical process that must satisfy two basic requirements. There must be an energy supply to provide heat of vaporization; and there must be some transport mechanism for removing the vapor. Combining these concepts it is possible to derive an expression for evaporation rate that depends only on measurable weather elements. By making some simplifying approximations, the weather data needed reduce to (a) duration of bright sunshine, (b) air temperature, (c) air humidity, and (d) wind speed. The quantity obtained is E_o, the evaporation rate for a hypothetical open water surface exposed to the measured weather. Formally, and empirically, it is possible to convert E_o into E_T, the potential transpiration rate from a short green-crop cover, completely shading the ground and never short of water. This computation has formed the basis of successful experiments in irrigation control; and, with reasonable empirical modification to allow for conditions when water supply becomes a limiting factor, has been applied with some success in studies of the water balance of catchment areas. Applied to two classical American watershed studies it suggests that some of the Coweeta results may need reconsideration.

Rowe, P. P. DIFFERENCE APPROXIMATIONS TO PARTIAL DERIVATIVES FOR UNEVEN SPACINGS IN THE NETWORK. Amer. Geophys. Union Trans. 36: 995-1008. 1955.

Difference expressions are developed which do not require even spacings in the network. These difference expressions are obtained by three different methods. The methods are Taylor's series expansion, operator calculus, and stencil mathematics. These difference expressions can then be applied in either the relaxation or iteration process. The errors involved in replacing the derivatives with these difference expressions are investigated. Most of these difference expressions are developed for use with the Laplace equation or the related equation, $h_{xx} + jh_{yy} = 0$.

Shulits, S. GRAPHICAL ANALYSIS OF TREND PROFILE OF A SHORTENED SECTION OF RIVER. Amer. Geophys. Union Trans. 36: 649-654. 1955.

The effect on the profile of shortening a stretch of river by one or more cutoffs is analyzed graphically. The method is based on the observation that river slope and particle characteristics of bed material are closely related. The constructed profile is that towards which it trends as a result of the rectification, but which it may never attain due to geologic and other unforeseen conditions. The time to reach this trend profile is still unpredictable. The method illustrates the consequences of the interplay of cutoffs.

Yatsu, E. ON THE LONGITUDINAL PROFILE OF THE GRADED RIVER. Amer. Geophys. Union Trans. 36: 655-663. 1955.

After examining the longitudinal profiles and the grain-size distribution of fluviatile deposits of nine main rivers in central Japan, graded profile is concluded not to be an exponential curve which has been considered as the most adequate description up to the present. It is due to the discontinuity of wearing out of bed load, that is to say, the sediments of 2 to 4 mm. in grain size are not easily produced and therefore comparatively of smaller quantity.

Climatology

Bates, R. P. CLIMATIC FACTORS AND CORN YIELDS IN TEXAS BLACKLANDS. Agron. Jour. 47: 367-369. 1955.

To obtain a better understanding of climatic factors limiting corn yields, correlation coefficients were calculated between several climatic factors and corn yields during 41 years, 1913-53.

Mean maximum temperature, mean relative humidity, and evaporation in June (the month in which corn is usually pollinated) were very closely correlated with corn yields. These three factors were closely correlated with each other, and since evaporation is dependent on tempera-

ture and humidity, the latter two factors appear to be those affecting corn yields. Each of these factors was more closely correlated with corn yields than was rainfall at any period of the year. The number of rains in June showed a higher correlation with yield than did any other rainfall factor. Rainfall in June was correlated more closely with yields than total rainfall during any other period. If rainfall during more than 1 month was considered, October 1 to August 1 showed the highest correlation with yields. Number of cloudy days in June was not closely correlated with corn yields and the correlation which existed was probably due to effects of rainfall, humidity, and temperature.

Rowland, E. F., Stolzy, L. H., and Crabb, G. A., Jr. FROST DETERMINATION BY ELECTRICAL RESISTANCE. Highway Res. Bd. Bul. 100. pp. 17-21. 1955.

The authors wrote a preliminary report on a new method of determining frost in the soil profile in situ. The method involves interpretation of electrical resistances obtained with a soil-moisture block and their associated soil temperatures, a method developed at the Michigan Hydrologic Research Station as a result of correlations noted from daily field records of soil moisture and temperatures. A hypothesis relating these phenomena was formulated and was substantiated by field and laboratory studies. Under certain conditions an abrupt 200-ohm increase in the electrical resistance of the plaster-of-paris moisture unit was a satisfactory indicator of the commencement of crystallization of moisture. Test instrumentation and graphic results of the laboratory tests are illustrated.

Wilkinson, J. H. STUDY OF RAINFALL STATION LOCATIONS IN SOUTH CHICKAMAUGA CREEK WATERSHED. Amer. Geophy. Union Trans. 36: 1021-1028. 1955.

A 428-sq. mi. watershed was studied to determine the number and location of reporting-rainfall stations needed to provide the desired accuracy of average watershed rainfall for stream-flow prediction purposes. Data on storms occurring during 12 months are analyzed and a chart presented which shows the probable difference from average watershed rainfall to be expected for winter storms when various numbers of best and random stations are used to estimate rainfall.

Land Use Influences

Anderson, H. W. DETECTING HYDROLOGIC EFFECTS OF CHANGES IN WATERSHED CONDITIONS BY DOUBLE-MASS ANALYSIS. Amer. Geophys. Union Trans. 36: 119-125. 1955.

Double-mass plotting of hydrologic events against a meteorological control is one way of detecting the effects of changes in watershed condition. This method of plotting showed what changes in sedimentation and peak inflow were associated with the occurrence of wildfires in the watershed above Gibraltar Reservoir, Santa Ynez Watershed, California. A meteorological control was calculated from the maximum daily precipitation of a storm and the precipitation during an antecedent period. Sedimentation of the reservoir and peak inflow increased markedly following the wildfires of 1932 and 1933, then decreased as the watershed recovered from the fires. No change in the total annual inflow was detected using the same method. The effects of changes in watershed condition must be taken into account in estimating long-term average sedimentation and flood frequency from the short-term records now available.

Hays, O. E. FACTORS INFLUENCING RUNOFF. Agr. Engin. 36: 732-735. 1955.

Protecting timber from fire and grazing produces a soil condition which will prevent runoff. The highest amounts of runoff were measured from spring grain following corn. During intense storms, runoff from cornland was less than from first-year hay. The older the hay, the more winter runoff and the less growing-season runoff. Second and third-year hay land yield one-fourth as much runoff as cornland and one-twelfth as much runoff as spring-grain land during intense, growing-season rains. Stripcropping and terracing are essential for controlling runoff and reducing soil losses on sloping silt loam soils in this area.

Scott, V. H. RELATIVE INFILTRATION RATES OF BURNED AND UNBURNED UPLAND SOILS. Amer. Geophys. Union Trans. 37: 67-69 1956.

To increase the value of rangeland densely covered by brush, a number of management practices are being employed. One practice, clearing by the use of fire, has raised the question as to its effect on the infiltration capacity of the soil. Application of single-ring infiltrometers for determining relative infiltration rates of upland soils is discussed. Values of the relative infiltration rates for burned and unburned areas are presented. In all cases the burned soils had substantially higher rates following a fire. One year later the results were similar with one exception.

Sedimentation

Glymph, L. M., Jr. STUDIES OF SEDIMENT YIELDS FROM WATERSHEDS. Publication No. 36 de l'Association Internationale d'Hydrologie, Rome, Italy, pp. 178-191. 1954.

Sediment yield of a watershed appears to be the result of multiple causal factors. Variations in the significance of the individual causal factors from one physiographic area to another probably accounts for the observed differences in sediment yield over the country.

The relationships between sediment yields and watershed characteristics are complex and not

yet well defined, but progress toward this end has been made by the techniques of statistical analysis. From what has been accomplished it seems that the problem is susceptible to treatment by the application of statistical procedures and that this approach provides the best hope for understanding the variation in sediment yields and a means for expressing the effects of watershed characteristics, including hydrologic aspects, upon sediment yield.

Limited space has not permitted inclusion and discussion of all such statistical analyses which have come to the author's attention. Indeed, it has not been the purpose of this paper to select, by comparison, any single empirical equation for estimating sediment yield. No universally applicable equation has been developed thus far and probably never will be. However, it is strongly indicated that the equation for the Texas Blacklands Prairies will give completely reliable results within that physiographic area for the range of drainage-area sizes which it represents.

The empirical equations used as illustrations in this paper are reviewed with the hope that they will stimulate thinking and determination to exploit this general approach to its fullest potentialities.

Heidel, S. G. THE PROGRESSIVE LAG OF SEDIMENT CONCENTRATION WITH FLOOD WAVES. Amer. Geophys. Union Trans. 37: 56-66. 1956.

Numerous investigations of suspended-sediment discharge have shown that an increase in streamflow usually is accompanied by an increase in sediment concentration. The sediment-concentration peak during a rise may precede, coincide with, or follow the water-discharge peak. Observations on the Bighorn River in Wyoming and Montana show a progressive lag in peak concentration behind peak flow. The lag is most apparent when a single storm produces a flood wave that starts many miles upstream from the sampling sections.

Woodburn, R. SEDIMENT PRODUCTION IN SMALL WATERSHEDS. Agr. Engin. 36: 467-470. 1955.

The a or discusses sediment-yield studies in Mississippi from 1949 to 1954 on small gullied areas, partly gullied areas up to 500 acres and one watershed of 12 square miles. A logarithmic relationship was derived from the data as follows:

$$S = \frac{W^{0.8957} T^{0.6573} E^{0.8573} C^{0.3423}}{2.578}$$

in which S = sediment in tons; W = watershed area, acres; T = age of reservoir, years; E= gross erosion rate, tons per acre per year (500 tons per acre-inch, average weight of upland soil); C = capacity watershed ratio, acre-feet per square inch.

Ground Water

Luthin, J. N., and Day, P. R. LATERAL FLOW ABOVE A SLOPING WATER TABLE. Soil Sci. Soc. Amer. Proc. 19: 406-410. 1955.

The lateral movement of water above a water table was studied under steady-state conditions. The dependence of the capillary conductivity on soil-moisture tension was considered in making a theoretical analysis of the problem.

Lateral flow was induced in a sand-filled tank by maintaining a small difference in head between constant reservoirs located on either side of the sand-filled tank. The experimentally determined values of hydraulic head and quantity of flow were then compared to the theory which considered the variations of capillary conductivity with soil-moisture tension. The hydraulic head determined at various points of the flow section in the steady-state experiment agreed approximately with values calculated from theory. The flow calculated from knowledge of the capillary and hydraulic conductivities agreed with the measured flow.

Hydraulic--Structures

Nelson, G. H. FLOW REGIMES OF A DROP-INLET SPILLWAY. Agr. Engin. 37: 177-179, 181. 1956.

Five flow regimes at the entrance to the drop-inlet spillway tower can be identified from both visual observation and head-discharge data. The hydraulic behavior of a spillway tower with change in geometric properties apparently depends on which flow regime occurs.

SOIL AND WATER MANAGEMENT

General

Bellinger, P. F. STUDIES OF SOIL FAUNA WITH SPECIAL REFERENCE TO THE COLLEMBOLA. Conn. Agr. Expt. Sta. Bul. 583. 1954.

This investigation was carried out with the following objectives in view: (1) to gather information about the composition of the soil fauna in certain local habitats; (2) to compare the fauna in these habitats and draw any conclusions possible about their similarities or differences and about the ecological limitations of the individual species; and (3) to study those phases of the biology of the species on which information could be gained from the analysis of periodic samples taken in the same areas. Particular attention was paid to the Collembola because of their abundance and the relative simplicity of determining specimens.

Soil and humus support a large fauna of arthropods, rich both in number of species and number of individuals. The Acarina are numerically the dominant group, followed by the Collembola. In addition the Chilopoda, Symphyla, Homoptera (soil aphids) Coleoptera, and Diptera are well

represented. Other groups of arthropods occur with relatively lower frequency. Some of the latter are true soil animals (Chelonethida, Entotrophi, Formicidae); others which may be collected in soil samples are inhabitants of the surface vegetation (many Hemiptera and Thysanoptera), or only temporarily present in the litter (Araneida, adult Diptera, and holometabolous pupae), or parasites of other species (mostly Hymenoptera).

Chisholm, D., MacPhee, A. W., and MacEachern, C. R. EFFECTS OF REPEATED APPLICATIONS OF PESTICIDES TO SOIL. Canad. Jour. Agr. Sci. 35: 433-439. 1955.

The effects of repeated applications of various pesticides to the soil were investigated during 1949 to 1953 in a field experiment at Kentville, N. S. Applications of arsenic, DDT, ferbam, and sulphur caused a decrease in the yields of some crops. DDT, arsenic, and BHC accumulated in the soil, whereas parathion and sulphur did not. There was evidence of translocation of parathion and BHC in plants. Arsenic, sulphur, ferbam, and BHC influenced the chemical composition of the soil.

Davis, J. F., and Engberg, C. A. A PRELIMINARY REPORT OF INVESTIGATIONS OF SUBSIDENCE OF ORGANIC SOILS IN MICHIGAN. Mich. Agr. Expt. Sta. Quart. Bul. 37: 498-505. 1955.

A study was started in 1948 to correlate subsidence with height of water table, pH, cropping practices, and other physical characteristics and conditions on peat and muck soils in Michigan. The areas selected represented a number of different types of situations, ranging from continuous pasture to continuous fallow.

Changes in surface elevation of three organic soil types, Carlisle muck, Houghton muck, and Rifle peat, at 13 sites were studied for 5 years. The range of subsidence was from 0.0 to 0.7 foot.

No correlation between subsidence and soil type was observed. No subsidence was measured at a site where a green-manure crop of rye was grown annually for 4 out of 6 years and 15 to 20 tons of manure applied for 2 years. Data were not sufficient to evaluate the correlation between subsidence and height of water table.

Ellis, H. H., and Bausman, R. O. SOME LEGAL ASPECTS OF WATER USE IN DELAWARE. Univ. Del. Agr. Expt. Sta. Bul. 314. 1955.

Use of Delaware's water resources by industries, municipalities, farm irrigators, and others has increased rapidly and some water users are beginning to experience seasonal or periodic water shortages. These shortages are increasing the possibility of disputes between water users regarding their legal rights to use water from various sources for certain purposes or on certain lands. This bulletin describes some of the Delaware laws relating to such questions, as well as some of the legal doctrines and statutes that have been developed in other Eastern and Western States.

Loughry, F. G. DESCRIPTIONS OF PENNSYLVANIA PROBLEM AREAS IN SOIL CONSERVATION. U. S. Dept. Agr. Soil Conserv. Serv. Harrisburg, Pa. 1955.

The soil conservation problems in Pennsylvania are many and varied. In a large degree, they depend on local combinations of soil, slope, climate, land use, type of farming, and other factors which are not uniform for the whole State. The map which accompanies this report is an attempt to outline areas which have a certain unity of land pattern and accompanying use and management features.

Salmon, S. C. RANDOM VERSUS SYSTEMATIC ARRANGEMENTS IN NON-LATIN SQUARE FIELD EXPERIMENTS. Agron. Jour. 47: 289-294. 1955.

It appears from the data presented in this paper that the advantages of good systematic arrangements in relation to the accuracy of the means are somewhat greater than previously published data indicated, and that it would be even more difficult than previously supposed to justify the use of random arrangements for all field experiments. This would seem to apply especially to field-plot experiments on land where a trend in yield from one end of a replication to the other is expected.

Stephens, J. C. SUBSIDENCE OF ORGANIC SOILS IN THE FLORIDA EVERGLADES. Soil Sci. Soc. Proc. 20: 77-80. 1956.

Subsidence of peat and muck soils in the Everglades has been observed and recorded since 1914. An average subsidence rate of about 1-1/4 inches per year was found by periodic survey over 15 profile lines. Water-table test plots showed that loss of peat soil depended directly upon depth of drainage. The relation is expressed by the equation $x = \frac{y-2.45}{14.77}$, in which x equals subsidence rate in inches per year and y equals average depth of water table in inches. This rate is about double that in similar studies by investigators in Indiana. Isopachous charts showing the original depth of the peat soils in 1912, in 1925, and in 1950 are shown for the agricultural area near Lake Okeechobee and projected to the year A. D. 2000. Steps which will minimize soil losses are outlined.

Stone, J. F., Kirkham, D., and Read, A. A. SOIL MOISTURE DETERMINATION BY A PORTABLE NEUTRON SCATTERING MOISTURE METER. Soil Sci. Soc. Amer. Proc. 19: 419-423. 1955.

A portable, battery-powered device for measurement of soil moisture by neutron scattering

was constructed and used for field measurements. The equipment, aside from being portable, differs from previously reported devices of this type as follows: (a) A fast neutron source in the form of an annulus is placed about the center of a slow neutron detecting tube; (b) recently developed glow transfer tubes are used for absolute neutron count determinations; and (c) a calibrating volume of paraffin, which is also used as a neutron shield, is incorporated as a part of the source-detector carrying case, to permit simple field checking and standardization of the device. The detector tube is partially shielded with cadmium to reduce the vertical extent of the soil sample contributing to the neutron count. Field data are presented. By locating the source-detector at various depths in pipes sunk vertically into the soil, except for the surface 6 to 9 inches, the equipment generally gave the soil moisture per unit soil bulk volume, within the range of the standard deviation of gravimetric determinations. A single calibration curve serves for all soils tested (sand, silt loam, silty clay loam).

Fertilizers and Soil Fertility

Allison, F. E. DOES NITROGEN APPLIED TO CROP RESIDUES PRODUCE MORE HUMUS? Soil Sci. Soc. Amer. Proc. 19: 210-211. 1955.

The rate of C in carbonaceous crop residues decomposing under different levels of N is considered. Laboratory and greenhouse results show that although N additions offset the harmful effect of such residues on crop growth, and often accelerate decomposition, such added N does not appreciably increase the percentage of the crop residue C that remains in the soil as humus. Nitrogen added to cropped soils does tend to maintain soil organic matter at a higher level than in its absence but this is due to the increased crop yields and resulting larger crop residues available for humus formation.

Anderson, C. E., and Purvis, E. R. EFFECTS OF LOW TEMPERATURES ON NITRIFICATION OF AMMONIA IN SOILS. Soil Sci. 80: 313-318. 1955.

Nitrification of NH_4OH was studied in Nixon sandy loam, Freehold loamy sand, Annondale loam, and Washington loam incubated at 37°, 42°, 47°, and 52° F. A comparison of the nitrification of NH_4OH and $(NH_4)_2SO_4$ was made in Nixon sandy loam at two pH levels. In Nixon sandy loam at initial pH 4.9 nitrification of $(NH_4)_2SO_4$ lagged at least 2 weeks behind that of NH_4OH. At initial pH 6.8 nitrification of both H sources was virtually the same.

Anderson, M. S. SEWAGE SLUDGE FOR SOIL IMPROVEMENT. U. S. Dept. Agr. Cir. 972. 1955.

Two widely differing general types of sewage-disposal systems are commonly used. These are (1) primary treatment with anaerobic digestion and (2) systems activated by injection of air. Digested sludge is usually of relatively low quality as a fertilizer compared with products from an activation system.

Dried activated sludge properly heat-treated normally commands a good price in fertilizer markets. Digested sludges, on the other hand, are often obtainable without cost or at a low price.

Determinations have been made of the chemical compositions of sludges variously prepared in different parts of the United States. The analyses include primary and secondary fertilizing constituents and several minor elements.

The N contents of activated sludges are normally much higher than those in digested products. The P contents of sludges vary widely, presumably dependent upon local conditions. Potassium is always low. The secondary elements--Ca, Mg, and S--in the quantities present probably are of little importance from a fertilizer standpoint. Several of the minor elements are present in quantities usually much higher than are frequently found in soils. The fertilizer importance of the minor elements present in sludges collected has not been determined. It is presumable that certain soil deficiencies might be corrected by adequate applications of sludges known to contain minor elements.

Anonymous. GENERAL FERTILIZER RECOMMENDATIONS FOR ALABAMA. Ala. Agr. Expt. Sta. Spec. Cir. 1955.

Fertilizer needs depend on the crop to be grown and the nature of the soil. Some crops have higher requirements for certain plant nutrients than others, and some soils, either because of origin or previous treatment, contain greater amounts of certain plant nutrients than others. Therefore, one fertilizer recommendation cannot be made for all conditions in Alabama.

To determine the fertilizer needs of different crops on various soils, studies were conducted with the important crops on the more extensive soil types of the State. The general fertilizer recommendations given herein are based on results obtained from these field tests.

Anonymous. PROFITABLE USE OF FERTILIZER IN THE MIDWEST. Wis. Agr. Expt. Sta. North Central Reg. Pub. 54. Dec. 1954.

This bulletin was prepared by the Subcommittee on Economics of Fertilizer Use of the North Central Farm Management Research Committee. It is a summary and an analysis of the factors involved when farmers individually make decisions about the kinds and rates of fertilizer to apply to particular crops. The prospective prices of the crops to which the fertilizer is applied is an important factor. But no attention is given to the aggregate influence of farmers' decisions and actions in the use of fertilizer on the national problem of balancing supply and demand for farm products.

Beeson, K. C. NUTRIENT ELEMENT CONTENT OF NATIVE FORAGE IN RELATION TO LOCATION AND LAND FORMS IN THE SOUTH CAROLINA COASTAL PLAIN. Soil Sci. 80: 211-220. 1955.

Soil and geological factors affecting the concentration of Ca, P, Co, Cu, Fe, and Mn in native forage types collected from the Atlantic Coastal Plain in South Carolina were studied. In each instance there were highly significant effects of location with respect to the marine terrace, drainage basin, or both.

The Talbot terrace with an elevation range of about 25 to 42 feet above sea level was clearly associated with the lowest concentrations of all the mineral elements determined. The Sunderland terrace, ranging from 100 to 170 feet in elevation, appeared to produce vegetation of higher mineral content.

The drainage basin of the Edisto and Ashley Rivers produced vegetation relatively low in P, Co, Cu, and Fe but high in Ca and Mn. An exception to this appears to be a relatively high Co concentration in vegetation from an area in the northeastern part of Charleston County.

In general, the level of Co in this type of vegetation over the entire area is very low and could not be expected to support unsupplemented grazing on unimproved pastures.

Brown, J. C., Holmes, R. S. and Specht, A. W. IRON, THE LIMITING ELEMENT IN A CHLOROSIS: PART I. AVAILABILITY AND UTILIZATION OF IRON DEPENDENT UPON NUTRITION AND PLANT SPECIES. Plant Physiol. 30: 451-457. 1955.

Four plant species which differed in their susceptibility to "lime-induced" chlorosis (Fe deficiency) and Cu deficiency were grown in soils of low available Fe supply (calcareous) and soils of low available Cu supply (organic). A continuous source of available Fe appeared necessary for the growth of all the plants studied, but the plant species differed in the concentration of available Fe required in the growth media to prevent Fe chlorosis. One of the four species was unable to absorb sufficient Fe from calcareous soil for normal growth.

Radioiron was supplied to chlorosis susceptible soybeans through approach grafts and seed. In each case, insufficient Fe was absorbed from the soil to prevent chlorosis when the available source of Fe was stopped or depleted. The radioiron in the plant did not move appreciably under these conditions.

The available Cu supply in the growth media seemed to have a marked effect upon the absorption and utilization of Fe by corn. Iron accumulated throughout the Cu-deficient plant (especially in the nodes) and the addition of Cu to the soil decreased this absorption. Both varieties of soybeans and wheat differed from corn in this respect. Wheat developed severe Cu-deficiency symptoms, corn only moderate symptoms, and the soybeans did not respond to Cu.

Brown, J. C., Holmes, R. S., and Specht, A. W. IRON, THE LIMITING ELEMENT IN A CHLOROSIS: PART II. COPPER-PHOSPHORUS INDUCED CHLOROSIS DEPENDENT UPON PLANT SPECIES AND VARIETIES. Plant Physiol. 30: 457-462. 1955.

Field and greenhouse experiments showed that the elements most consistently affected in a comparison of chlorotic and nonchlorotic leaves were Cu, P, and Fe. Copper and phosphorus were higher and iron lower in chlorotic than in nonchlorotic leaves.

Under the conditions of these experiments, increasing additions of P did not affect the absorption or utilization of Fe, to the extent that chlorosis developed, unless Cu was also present in the growth media. Copper and phosphorus were more effective in producing chlorosis if applied together, than if either element was applied separately. Plant species and varieties investigated differed in their susceptibility to this Cu-P induced Fe chlorosis.

Caldwell, A. C., Hustrulid, A., and Hammers, F. L. RESIDUAL AVAILABILITY IN THE SOIL OF VARIOUS SOURCES OF PHOSPHATE AS MEASURED BY PLANT ABSORPTION OF P^{32} AND BY SOIL TEST. Soil Sci. Soc. Amer. Proc. 20: 25-28. 1956.

Ordinary superphosphate, concentrated superphosphate, Ca metaphosphate, liquid phosphoric acid, fused tricalcium phosphate, rock phosphate with colloidal clay, and rock phosphate were broadcast annually on a Kenyon silty clay loam at the rate of 40 pounds of P_2O_5 per acre per year for 6 years. Rock phosphate was also broadcast annually at the rate of 100 pounds of P_2O_5 per acre per year. Yields were secured of grain, mixed legume hay, and corn grown across these treatments. The only crop showing consistent increases in yield was mixed legume hay, and the phosphates giving responses were those in which the P was in water- or citrate-soluble form or both.

The seventh year 20 pounds of radioactive superphosphate was applied across the various phosphate treatments on hay, wheat, and corn. Available P in the soil calculated from absorption data was greater--sometimes 100 percent or more--in the soils that had received ordinary superphosphate, concentrated superphosphate, calcium metaphosphate, fused tricalcium phosphate, and liquid phosphoric acid, than in check plots or those that had received the rock phosphates. Available P in the check and rock phosphate plots was essentially the same, as measured by absorption data. There was close correlation between Bray's adsorbed P soil test and the available P in the soil as indicated by absorption of P^{32}, but this was not true for Bray's adsorbed and acid-soluble P or the Thornton soil test for soil P.

Carpenter, P. N., and Struchtemeyer, R. A. THE EFFECT OF THE ADDITION OF VAMA TO SOIL UPON UPTAKE OF PHOSPHORUS AND THE UTILIZATION OF PHOSPHORUS APPLIED IN FERTILIZER BY THE OAT PLANT. Agron. Jour. 47:530-531. 1955.

Oats were grown during the years 1952 to 1954 in soil which was treated with VAMA, tagged superphosphate, K chloride, and ammonium nitrate. Results indicate that the oat plant can more efficiently use both soil and fertilizer P when VAMA is not present in the soil.

Cheaney, R. L., Weihing, R. M., and Ford, R. THE EFFECT OF VARIOUS RATES AND FREQUENCIES OF APPLICATION OF ROCK AND SUPERPHOSPHATE ON THE YIELD AND COMPOSITION OF FORAGE ON A LAKE CHARLES CLAY LOAM SOIL. Soil Sci. Amer. Proc. 20: 66-68. 1956.

The effects of various rates and frequencies of application of rock and superphosphate on the yield and chemical composition of pasture forage was studied on a Lake Charles clay loam soil. The amount of P_2O_5 in pounds per acre from each source and the frequency of fall application of this amount were 30 lbs. every year, 60 lbs. every 2 years, 120 lbs. every 4 years, 240 lbs. every 8 years, and 480 lbs. every 16 years. The area was seeded to a pasture mixture of Dallis grass and white, Persian, and hop clovers. Yield and chemical data are reported for the first 4 years, 1950-53. At the end of the fourth year, four yearly 30-pound applications and two 60-pound applications of P_2O_5 from superphosphate had equaled and surpassed the production from single applications of 120 and 240 pounds of P_2O_5 from the same source. There appeared to be a similar trend with rock phosphate; however, the yearly 30-pound application has not proved very effective to date.

Clark, K. G., Yee, J. Y., Gaddy, V. L., and Lundstrom, F. O. SOLUBILITY RELATIONSHIPS AND NITRIFICATION CHARACTERISTICS OF UREA-FORM. Agr. and Food. Chem.

Solubility relationships and nitrification characteristics are reported for urea-formaldehyde reaction products ranging from 0.75 to 1.4 in mole ratio of urea to formaldehyde. Although possible suitability of such materials for fertilizer use is indicated by $U/F > 1$, increases in this ratio are not necessarily directly related to improved solubility and nitrification characteristics. The primary components of the neutral permanganate activity, the solubility pattern, and the activity index recently adopted by the Association of Official Agricultural Chemists, were found to be highly correlated with the degree of nitrification observed in 3 weeks of incubation. Increase in nitrification between 3 and 15 weeks of incubation was more highly correlated with the secondary components of the solubility pattern and activity index than with that of the permanganate procedure. In consequence, the solubility pattern procedure and the recently adopted activity index, $AI \geq 40$, are considered more reliable than neutral permanganate activity in characterizing the suitability of urea-formaldehyde materials for fertilizer use.

Clark, K. G., and Gaddy, V. L. COMPOSITION AND NITRIFICATION CHARACTERISTICS OF SOME SEWAGE AND INDUSTRIAL SLUDGES--1952. Farm Chemicals, pp. 41-43. 1955.

Analytical data are presented with reference to the N, P, K, Ca, Mg, Fe, S, B, Cu, Mn, Mo, Zn, and ash contents of 18 sewage and industrial sludges collected or produced in 1952. The overall composition of the sewage products appears to have been affected only slightly, if at all, by the recent trends toward increased use of household garbage disposal units and synthetic detergents in urban areas. The quality of the N content of the sludges for fertilizer use, as determined by nitrification procedures, was substantially lower in all cases than soluble chemical N, but was highest for the activated sludges and lowest for the industrial sludges.

Clark, L. J., and Axley, J. H. MOLYBDENUM DETERMINATION IN SOILS AND ROCKS WITH DITHIOL. Analytical Chem. 27: 2000-2003. 1955.

A simple colorimetric method is presented for the determination of submicrogram traces of Mo in soils and rocks. The procedure is developed on the extractable green complex formed between Mo and dithiol. Interference by ferric Fe is eliminated by reduction with K iodide and Na thiosulfate. Isoamyl acetate extracts of the molybdenum-dithiol complex are color-stable. Photometric measurements permit accurate determinations over the range of 0.02 to 10 γ of Mo in mineral materials.

Cook, E. D., and Parmer, W. R. GRAIN SORGHUM FERTILIZER TESTS AT THE BLACKLAND EXPERIMENT STATION, 1952-54. Texas Agr. Expt. Sta. Prog. Rpt. 1803. 1955.

Grain sorghum fertilizer tests were conducted during 1952-54 on Bell clay and Houston Black clay soils near Thrall and on irrigated bottom land near Rogers.

Phosphoric acid (P_2O_5) alone or in combination with N significantly increased yields in the tests near Thrall. The lower rates of N were as effective as the higher rates. Nitrogen or potash alone did not increase grain yields. The best treatment on the Bell clay was 15-30-0 and on the Houston Black clay 0-30-0.

On the irrigated bottom land, N or P_2O_5 alone or in combination significantly increased yields in 1953. The yields were erratic in 1954 but were increased significantly by 90 pounds of N alone and by all of the treatments in which both N and

P_2O_5 were applied. The most economical treatment was 30-45-0.

Drake, M., and Steckel, J. E. SOLUBILIZATION OF SOIL AND ROCK PHOSPHATE AS RELATED TO ROOT CATION EXCHANGE CAPACITY. Soil Sci. Soc. Amer. Proc. 19: 449-450. 1955.

Plants with root cation exchange capacities ranging from 10 to 60 me./100 gr. dry root, were grown in greenhouse pots on B horizon Merrimac silt loam very low in available and total P. Rock phosphate at the rate of 1,000 pounds per acre was mixed throughout the soil. Plants with high cation exchange root systems (ragweed and smartweed) were more effective in obtaining P from soil and rock phosphate for themselves, and were 2 to 3 times as effective as the lower exchange root systems (Lamb's quarters and wheat) in solubilizing soil and rock phosphate for the following crop of sudangrass. Oats with relatively low cation exchange roots, when grown in association with red clover (high cation exchange roots) contained 60 percent more P than oats alone. Plant roots with high cation exchange capacity bond Ca with greater energy than low cation exchange roots. Two important mechanisms of P release are believed to be involved, (a) bonding of Ca by the plant root colloid to dissolve the rock phosphate crystal and (b) complexing of Al and Fe by organic anions to solubilize soil Al and Fe phosphates.

Ellis, R., Jr., Quader, M. A., and Truog, E. ROCK PHOSPHATE AVAILABILITY AS INFLUENCED BY SOIL pH. Soil Sci. Soc. Amer. Proc. 19: 484-487. 1955.

The influence of the pH of the culture medium on the availability of rock phosphate to oats was investigated by means of two sets of pot cultures. In one set, quartz sand containing 1 percent of montmorillonite clay served as the culture medium. Samples of the clay, previously saturated with H+, were treated with varying amounts of $Ca(OH)_2$ to provide a series of samples having pH values of 4.9, 5.5, 6.2, 6.7, and 7.4, respectively. Addition of these clays to quartz cultures imparted their respective pH's to the cultures. In one series, rock phosphate served as a source of P, and in a second, superphosphate served similarly. All other nutrients were supplied in soluble forms. The yield with rock phosphate was highest at pH 5.5. With superphosphate yields were good throughout and about double those with rock phosphate. A soil pH of 6.0 or lower appears to be necessary for satisfactory utilization of rock phosphate.

In a second set of pot cultures, Spencer silt loam subsoil of pH 5.1 and very low in organic matter, and available P served as the culture medium. Other nutrients than P were supplied in available forms. When rock phosphate was applied 1 month prior to liming to pH 7, the oats grew much better and absorbed much more P than when the order of applications was reversed, showing that strongly acid soils act on rock phosphate rather rapidly, and that for rock phosphate to be effective acidity is needed. Thus, it is advisable to apply rock phosphate a year or more in advance of liming.

Eno, C. F., and Reuzer, H. W. POTASSIUM AVAILABILITY FROM BIOTITE, MUSCOVITE, GREENSAND, AND MICROCLINE AS DETERMINED BY GROWTH OF ASPERGILLUS NIGER. Soil Sci. 80: 199-209. 1955.

Unweathered biotite, muscovite, greensand, and microcline were dry-ground and separated into sand, silt, and clay fractions. By modifications of the Aspergillus niger method for determining available soil K, these mineral fractions were compared as sources of K.

When A. niger was grown at various levels of K it responded with increased pad weight and K uptake. Biotite, muscovite, and microcline produced large increases in pad weight and K released when the particle size of the minerals was reduced. Greensand showed little change in release of K as related to particle size; this was also reflected in pad weights of A. niger. Growth of A. niger increased the release of K from all minerals. Percentage K in the mycelium increased with increases in K in the nutrient solution. The increased release of K from the minerals, as a result of growth, probably was caused by the increased acidity and the effect of a shift in the K equilibrium as a result of the absorption and removal of K by A. niger.

Fisher, F. L., Caldwell, A. G., and Fudge, J. F. EFFECT OF FERTILIZERS ON YIELD AND COMPOSITION OF PASTURE FORAGE NEAR COLLEGE STATION. Prog. Rpt. 1811. September 10, 1955.

A pasture fertility study was conducted on a Lufkin fine sandy loam near College Station during 1940-51. The use of a complete fertilizer produced the maximum quantity of forage and the quality was somewhat better than the native unfertilized forage. Nitrogen and phosphorus used alone or in combination increased forage production; potash did not increase forage production unless it was applied with N.

In general, the nutritive quality of the forage was improved by the use of a complete fertilizer. A fertilizer nutrient used alone increased the content of that nutrient in the forage but reduced the others. The only serious quality problem was P, which was low where no phosphatic fertilizer was used.

Fiskel, J. G. A., Mourkides, G. A., and Gammon, N., Jr. A STUDY OF THE PROPERTIES OF MOLYBDENUM IN EVERGLADES PEAT. Soil Sci. Soc. Amer. Proc. 20: 73-76. 1956.

Analyses of samples of Everglades peat from the vicinity of Lake Apopka, Fla., showed a ten-

fold variation in total Mo between fields, while the water-extractable Mo ranged from 0.017 to 2.60 p.p.m. on the basis of the weight of oven-dry peat. The water-extractable fraction was in appreciable quantity at all depths. Subsequent leaching with other extractable solutions used in sequence on the same samples, showed the following range of values expressed as p.p.m. Mo of the oven-dry peat: one sequence 0.017 to 1.10 using borax in the rate of 50 pounds per acre in water, and 0.22 to 0.37 in the leachate following addition of superphosphate at the rate of a ton per acre ; another sequence 0.03 to 0.07 p.p.m. removed by neutral N NH_4Ac, followed by 0.044 to 0.120 p.p.m. removed in the leachate using 0.05 percent hydroquinone in 50 percent alcohol, and finally 2.5 to 10 p.p.m. with 1 N NH_4OH. Several materials were added to the peat on pasture areas, the rates being 750 pounds per acre each for kaolin, vermiculite fines, ball clay, colloidal phosphate, bauxite, and attapulgite; 500 pounds per acre of a Krilium-9 formulation and of sulfur powder; 200 pounds per acre of Krilium-931 formulation; and 150 pounds of a Mn-source material (Nu-M) and of a Cu-source material (Tri-basic Cu sulfate). Of these materials attapulgite, Krilium, and bauxite reduced the water-extractable and ammonium hydroxide-extractable Mo in the peat and also significantly reduced the Mo content of the herbage. Attapulgite and perhaps bauxite offered a longer lasting and less expensive measure of controlling Mo availability than the S or the Krilium formulations.

Fitts, J. W., Welch, C. D., and Nelson, W. L. SOIL TEST SUMMARIES FOR PREDICTING FERTILIZER RATIOS AND TYPE OF LIME NEEDED. Soil Sci. Amer. Proc. 20: 36-40. 1956.

Soil test summaries were instrumental in preparing general fertilizer recommendations on an area basis rather than for the State as a whole. Results for P and K, when summarized together in a two-way table, give a good indication of the ratios of these nutrients most needed in fertilizers. The summary tables were blocked off to show the number of pounds of P_2O_5 and K_2O recommended at different fertility levels for the various crops. The percentage of samples in the various categories indicates the proportion of fertilizer ratios needed.

Two-way summary tables were prepared to determine the relationship of Ca and Mg in North Carolina soils. Regardless of soil region, crops grown, or the level of Ca and Mg, the ratio of the two elements remained remarkably constant. In general, the ratio of Mg to Ca was about 1 to 5 which indicates that most soils throughout the State that need liming should receive a dolomitic limestone.

Gammon, N., Jr., Fiskel, J. G. A., and Mourkides, G. A. UPTAKE OF MOLYBDENUM FROM EVERGLADES PEAT BY SEVERAL GRASSES AND BY WHITE CLOVER. Soil Sci. Soc. Amer. Proc. 19: 488-491. 1955.

This study reports the Mo content of several grasses and clover that are grown in the Florida Everglades. Samples of clover from several fields had about the same Mo content as the grass herbages. There was considerable variability in the Mo content of the different grasses tested. Kentucky 31 fescue, Pensacola Bahia, St. Augustine, Pangola and Coastal bermudagrass, and white clover contained about 0.1 to 0.3 p.p.m. Mo in pot studies on unlimed peat, and 0.4 to 0.8 p.p.m. Mo on limed peats under greenhouse conditions. Under field conditions, the Mo content of these same herbages was much greater. Species taken from corresponding locations showed small variation in Mo content during the growing season when the pasture was well established, but initial samples taken at the time of the establishment of the pasture were much higher. On sandy soils, both Pangola grass and clovers showed a much higher Mo content for considerable periods after Mo fertilization, but no increase in yields. The Mo content of clover appears adequate where the soil has been limed. High fertilization of the pastures on peats and mucks high in Mo, followed by removal of the hay, and feeding the cattle on low Mo areas is suggested both to provide drier forage and to prevent return of the Mo to the pasture by manure and urine.

Goates, J. R., and Anderson, K. H. ACIDIC PROPERTIES OF CLAY MINERALS. Soil Sci. 80: 19-25. 1955.

Titrations of dialyzed clays and Al_2O_3 samples were made with $NaOC_2H_5$ in absolute C_2H_5OH. The data are analyzed by means of a Langmuir type equation, which shows two very definite and fairly homogeneous types of acid sites in each system.

Grunes, D. L., Haas, H. J., and Shih, S. H. EFFECT OF LONG-TIME DRYLAND CROPPING ON AVAILABLE PHOSPHORUS OF CHEYENNE FINE SANDY LOAM. Soil Sci. 80: 127-138. 1955.

Available P in the surface layer of Cheyenne fine sandy loam subjected to various cropping systems for 38 years was evaluated by several different methods. The results were compared to similar analyses on virgin samples of the same soil type.

Virgin Cheyenne fine sandy loam surface soils tended to be low in available P and their P status was about equal to that of the unmanured rota-

tions. By contrast, the soil organic C and N decreased considerably by 38 years of rotation cropping.

Organic P, like organic matter, was higher in the virgin soils than in the unmanured rotations. Organic P decreased as organic C and total N decreased. Manured rotations were considerably higher in available P than were plots that did not receive manure. Plots receiving manure every 3 years were higher in available P than were those receiving manure every 4 years. Addition of manure did not appear to increase organic P.

Haynes, J. L., and Thatcher, L. E. CROP ROTATIONS AND SOIL NITROGEN. Soil Sci. Soc. Amer. Proc. 19: 324-327. 1955.

Evidence from a 39-year record of corn yield from crop-rotation experiments in Ohio on Wooster silt loam soil fails to show long-term cumulative trend effects of commonly used cornbelt rotations on soil productivity. Yield levels characteristic of a given rotation were quickly reached with no pronounced trends thereafter. In general, yield level was associated with soil N level. Long-term downward trends in apparent soil productivity level were observed under conditions of continuous cropping to corn and under conditions of severe erosion.

Hellmers, H., Bonner, J. F., and Kelleher, J. M. SOIL FERTILITY: A WATERSHED MANAGEMENT PROBLEM IN THE SAN GABRIEL MOUNTAINS OF SOUTHERN CALIFORNIA. Soil Sci. 80: 189-197. 1955.

Erosion is a serious problem in the San Gabriel Mountains in southern California. The existing sparse vegetative cover does not protect the soil surface from wind, and temperature extremes. Lack of water is admittedly a factor in controlling growth of vegetation in this area. Soil nutrition also is a controlling factor.

To native plant species and mountain soils, nine nutritional elements (N, P, K, Ca, B, Cu, Mn, Mo, and Zn) were supplied in the laboratory. It was determined that plant growth could be greatly stimulated by addition of N. An even greater stimulation was produced by adding N and P together.

The relationship between soil fertility and the natural supply of water was tested in the field. Plots were treated with N, P, and a combination of these elements. The results showed that N alone stimulated growth of the shrubs. Nitrogen and phosphorus in combination failed to produce significant further increases in shrub growth. From this it was concluded that lack of available moisture for plant growth became critical before all the naturally available P was used by the plants.

Hobbs, J. A. THE EFFECT OF CROP ROTATIONS AND SOIL TREATMENTS ON SOIL PRODUCTIVITY. Soil Sci. Soc. Amer. Proc. 19: 320-324. 1955.

Permanent fertility studies were set up on the Agronomy Farm of Kansas State College in 1909 to determine the longtime effects of crop rotations and of soil treatments on the productive capacity of the soil. Trends in soil productivity induced by the different rotations and the different soil treatments were analyzed for the 42 years, 1911-52.

The analysis showed that, despite improved wheat varieties used during the investigations, the yields of unfertilized wheat and of unfertilized corn were maintained only in a 16-year rotation. Legume yields were not maintained in any rotation studied.

Wheat yields indicate how various combinations of commercial fertilizers, rock phosphate, lime, and manure increased the productive capacity of the soil. Corn yields indicate that only treatments including N increased soil productivity for this crop. Soil treatments increased alfalfa yields. Alfalfa yields, however, were not maintained at the original level by any soil treatment.

Hunter, A. S., and Yungen, J. A. THE INFLUENCE OF VARIATIONS IN FERTILITY LEVELS UPON THE YIELD AND PROTEIN CONTENT OF FIELD CORN IN EASTERN OREGON. Soil Sci. Soc. Amer. Proc. 19: 214-218. 1955.

Thirteen fertilizer experiments with field corn were conducted on irrigated sierozemic soils of Malheur County, in extreme eastern Oregon, for 3 years to determine the fertility status of the soils, the fertilizer needs of the crop, and the correlation between laboratory soil-test data and crop responses to fertilizers. They were carried out in the fields of cooperators, under conditions of the customary planting, tillage, and irrigation practices of the farms. Plant populations ranged from 9,700 to 21,400 plants per acre. Experiments included rates of N application up to relatively high levels, with and without added P_2O_5; additional treatments included K_2O. Grain was analyzed for crude protein.

Significant yield responses to N were obtained in 10 of 13 experiments. Maximum or near-maximum yields were produced, in most cases, by 100 lbs. N per acre. Protein content and total protein per acre in harvested grain increased with N application rate. Percentage of applied N recovered in the grain decreased with increased N. Efficiency of N in producing increased yield varied greatly with site and rate of N application. Very substantial residual effects of N applied to corn were observed on wheat the following year. No responses to P or K were found.

Ibach, D. B. A GRAPHIC METHOD OF INTERPRETING RESPONSE TO FERTILIZER. U. S. Dept. Agr. Agr. Handbook 93. 1956

The exponential equation used here lends itself well to graphic methods of estimating response to fertilizers. The most profitable rate of a fertilizer can be read directly from a graphically fitted curve. The most profitable combination of two or more nutrients may be calculated readily after the constants of the equation are found by graphic methods for each nutrient. When they are carefully done, graphic methods yield results that closely approximate those obtained from mathematical determination of the constants. Graphic methods of using the exponential equation are easily followed by those unfamiliar with statistical techniques, who often need to make recommendations as to use of fertilizer based on results of rate experiments.

Karim, A., and Khan, D. H. VERTICAL DISTRIBUTION OF NITROGEN, PHOSPHORUS, AND POTASSIUM IN SOME PAKISTAN SOIL. Soil Sci. 81: 47-56. 1956.

A study of the distribution of different forms of N, P, and K in the profile and its bearing on the pedogenic characteristics of some Gray-Brown Podzolic soils of East Pakistan led to the following conclusions:

Organic N gradually decreased down the profiles. It constituted the bulk of total N. The ammonia and nitrate N content of the soils was very low. An eluviation-illuviation of different forms of P; namely, inorganic, organic, R_2O_3-bound, Fe-bound, and adsorbed P has taken place in the profiles.

The rate of breakdown and disappearance of organic P down the profiles was much less than that of organic C. The average C/P and H/P ratios of the soils were 12.2 and 11.8, respectively. Adsorbed P showed a positive correlation with available P. Adsorbed K_2O also showed a direct though slight relation to available K_2O.

Kumagai, R., and Hardesty, J. O. RELATIVE EFFECTIVENESS OF GRANULE COATING AGENTS. Agr. and Food Chem. 4: 132-135. 1956.

This study evaluates the effectiveness of 17 different coating agents in reducing the caking tendency of a 12-12-12 granular fertilizer. Effectiveness of coating agents was closely related to relative bulk densities. Additions of 2 percent of hydrated silica, synthetic Ca and Mg silicates, and diatomaceous earth with bulk densities of 7 to 15 pounds per cubic foot reduced crushing strength of fertilizer cake 54 to 71 percent. Calcium carbonate, pyrophyllitic clay, and spent fuller's earth with bulk densities of 42 to 55 pounds per cubic foot effected reductions of less than 17 percent. The ability of coating agents to reduce or eliminate caking of granular fertilizers is dependent on the initial moisture content of the mixture, particle size and shape of the granules, and kind and amount of agent used.

Lipps, R. C., and Fox, R. L. SUBIRRIGATION AND PLANT NUTRITION: II. UTILIZATION OF PHOSPHORUS BY ALFALFA FROM THE SOIL SURFACE TO THE WATER TABLE. Soil Sci. Soc. Amer. Proc. 20: 28-32. 1956.

Utilization of P by subirrigated alfalfa from the soil surface to the water table was studied. Total and available P content of soils from adjacent fields, one cropped intensively to alfalfa and the other having little or no alfalfa history, were compared.

Longtime alfalfa culture resulted in substantial reductions of total and available P to a depth of 11 feet. Phosphorus utilization by subirrigated alfalfa was correlated with available moisture in soils. Soils with shallow water tables (10 feet or less) have water at relatively low tension throughout their profiles. Root activity is concentrated mainly in the surface soil gradually decreasing with depth. Intense root activity in the surface 3 feet of soils having relatively deep water tables (10 to 20 feet) appears to be associated with moisture from precipitation which is usually available for only a part of the growing season. Less intense but more constant root activity is to be expected in the region of capillary moisture above the water table. Decreased P utilization between these two regions coincides with a relatively dry area with consequent low root activity.

Mackie, W. Z., and Fried, M. RELATIVE DISTRIBUTION OF POTASSIUM AND RUBIDIUM 86 WITHIN CORN PLANTS GROWN IN THE FIELD. Soil Sci. 80: 309-312. 1955.

Corn was grown in a field experiment at three levels of K. The K treatments also contained tracer amounts of radioactive Rb. The Rb/K ratio in the reproductive parts of the plant was significantly higher than in the leaves, nodes, and internodes. The leaves, nodes, and internodes did not differ significantly in their Rb/K ratios.

MacLean, A. J., and Cook, R. L. THE EFFECT OF SOIL REACTION ON THE AVAILABILITY OF PHOSPHORUS FOR ALFALFA IN SOME EASTERN ONTARIO SOILS. Soil Sci. Soc. Amer. Proc. 19: 311-314. 1955.

The yields and P contents of alfalfa grown with and without P fertilizer in 6 soils previously limed to different pH levels in pots, and the amounts of P extracted with 4 chemical methods from soil samples taken prior to seeding and after harvesting the crop, were used to evaluate the effect of soil reaction on the availability of native and applied P for alfalfa.

The greatest uptake of P by alfalfa occurred at a pH of about 7.5, the highest level employed in the experiment. In most instances, the P contents of the plants were highest at a pH of about

7.5, at which level the yields were either similar to or higher than those obtained at any lower pH.

The results for P in most of the soils as measured with the Truog and Na-bicarbonate methods and for Bray adsorbed P in 3 of the soils showed that liming to or slightly above the neutral point increased the amounts of available soil P.

MacLean, A. A., Doyle, J. J., and Hamlyn, F.G. FERTILITY STUDIES ON SOME NEW BRUNSWICK SOILS: I. SOIL PHOSPHORUS SUPPLY AS SHOWN BY GREENHOUSE AND CHEMICAL TESTS. Canad. Jour. Agr. Sci. 35: 388-396. 1955.

Fertility investigations were conducted on soils collected from 6 farms on each of 5 soil types occurring in the Saint John River Valley. The effect of applied P on the yield and P content of ladino clover served as a basis for evaluating several chemical methods used in assessing the P status of different soils.

Applied P resulted in highly significant increases in yield and percentage of P in the crop on all soils. The degree of response, however, was not the same on all soil types. The higher the P content of the crop grown without P fertilizer, the lower was the increase in yield from applied P.

The soil P levels, as determined by 7 of 9 methods used, varied significantly between soil types. A positive correlation was found between soil P values, as obtained by 6 of the methods, and soil pH. The amounts of P extracted by two of the procedures employed decreased with increasing clay content.

Correlation coefficients relating soil P values and greenhouse results were highly significant for 3 of the 9 methods employed.

MacLean, A. J., Lutwick, L. E., and Bishop, R. F. FERTILITY STUDIES ON SOIL TYPE: VI. THE EFFECT OF CONTINUED CROPPING IN THE GREENHOUSE ON THE POTASSIUM SUPPLYING POWER OF SOILS. Canad. Jour. Agr. Sci. 35: 397-406. 1955.

In each of 4 successive years, oats and alfalfa were grown in the greenhouse with 4-10-0 and 4-10-10 fertilizer applied annually at the rate of 400 lbs. per acre on samples of surface soil from 9 farms on each of 10 soil types occurring in the Ottawa district. The amounts of K removed by the crops decreased appreciably after the first year. The effect of applied K on the uptake of K by the crops was more pronounced after 1 year of cropping, but the relative effect on the different soils was quite similar for the different years of cropping.

The value for exchangeable K in each of the soils and for nonexchangeable K extracted with normal nitric acid in most of the soils were reduced significantly as a result of cropping. It was estimated from the average results that the reduction in exchangeable and nonexchangeable K amounted to about 12 and 44 percent, respectively, of the uptake of K by the harvested crops.

McCall, W. W., Davis, J. F., and Lawton, K. A STUDY OF THE EFFECT OF MINERAL PHOSPHATES UPON THE ORGANIC PHOSPHORUS CONTENT OF ORGANIC SOIL. Soil Sci. Soc. Amer. Proc. 20: 81-83. 1956.

Laboratory studies were conducted to investigate the effect of mineral phosphates upon the organic P content of 8 organic soils. Soil types represented were Carlisle muck, Everglades peat, Houghton muck, Istopoka peat, and Rifle peat. Six of the samples were obtained in Michigan and 2 from Florida. Monocalcium phosphate was applied to each soil at the following rates: 12.5, 25, 50, 100, and 200 p.p.m. of P. Unphosphated samples were left as controls. To determine if mineralization was as extensive as shown by analyses for organic P, available soil P was determined before and after a 4-month incubation. The effect of sterilization, temperature, and moisture upon the mineralization of organic P in Houghton muck was also determined.

Samples were incubated for 4 months and the amount of organic P determined, at the end of 2, 3, and 4 months.

No fixation of mineral phosphate as organic P occurred, but mineralization of the original organic P did occur. In general, the trend was toward more complete mineralization of the soil organic P, with increasing rates of added monocalcium phosphate, over 4 months. Generally, the rate of mineralization was rapid the first 2 months and somewhat slower during the last 2 months of incubation.

The percentage increase in available P after 4 months incubation ranged from 31.1 to 292.0 percent.

Temperature and moisture were shown to be two factors affecting mineralization of organic P.

McClung, A. C., and Lott, W. L. A SURVEY OF THE NUTRIENT COMPOSITION OF LEAF SAMPLES FROM NORTH CAROLINA PEACH ORCHARDS. Soil Sci. Soc. Amer. Proc. 20: 10-15. 1956.

A group of 153 leaf samples was collected from North Carolina peach orchards from 1950-52 using sampling techniques which were standardized in respect to date of sampling and leaf age and position. The samples were analyzed spectrographically for P, K, Ca, Mg, B, Cu, Mn, Fe, and Al. Zinc and nitrogen were determined by chemical methods. The data are discussed to show broad general trends in the nutrient status of trees in a particular area and to use this information as a basis to establish or expand soil fertility investigations.

Levels of P, K, and Mn were well above the deficiency ranges for peaches as reported from this and other areas. Clear-cut foliar symptoms of deficiencies of Mg and Zn were noted in some

orchards, and leaf analyses indicate near deficiency in other orchards. Leaf levels of Fe, B, and Ca were low as compared with results from surveys in other areas. Foliar symptoms of Fe deficiency and symptoms possibly due to B deficiency were noted in some orchards. Symptoms of Cu deficiency were not observed here, nor have they been described for peaches elsewhere. Leaf levels of Cu were in many orchards lower than the levels of adequacy reported for other crops.

Mederski, H. J., and Wilson, J. H. EFFECT OF SOIL TEMPERATURE AND SOIL MOISTURE ON MANGANESE ABSORPTION BY SOYBEAN PLANTS. Soil Sci. Soc. Amer. Proc. 19: 461-463. 1955.

Periodic field observations of the development of Mn deficiency symptoms in soybeans indicate that soil temperature and soil moisture may influence Mn absorption by soybean plants. These observations were explored in detail in a greenhouse study.

Glazed pots were filled with a Mn deficient clay soil, placed in constant temperature water baths and planted to soybeans. One bath was maintained at 15° C., a second at 27° C., while the third was maintained at 15° C. for the first 7 weeks' plant growth and increased to 27° C. for the remaining 5 weeks' growth. Two soil-moisture levels were provided at each soil temperature.

A low soil temperature combined with high soil moisture was conducive to the development of severe foliar symptoms of Mn deficiency. High soil temperature combined with low soil moisture produced plants which exhibited only a slight Mn chlorosis. The total Mn per plant and the Mn concentration within the plant were significantly greater at the high than low soil temperature. In a solution culture study, increasing the temperature of the solution increased the Mn concentration in the soybean leaves indicating a physiological response of the plant to a change in root temperature.

Menzel, R. G., and Heald, W. R. DISTRIBUTION OF POTASSIUM, RUBIDIUM, CESIUM, CALCIUM, AND STRONTIUM WITHIN PLANTS GROWN IN NUTRIENT SOLUTIONS. Soil Sci. 80: 287-293. 1955.

Radioisotopes have been used to measure the relative uptakes of certain heavy elements and chemically similar essential nutrient elements. Rubidium and potassium were absorbed by millet, oats, buckwheat, sweetclover, and sunflower in a ratio of 0.85 times the ratio of their concentrations in nutrient solutions, but they were not uniformly distributed within the plants. Rubidium tended to concentrate in the flowers and young leaves of the test plants and in the roots of all except buckwheat. Cesium was adsorbed only 0.2 times as rapidly as P, but otherwise was distributed similarly to rubidium. Strontium and calcium were absorbed in a ratio 1.1 times the ratio of their concentrations in the nutrient solutions, but Sr was concentrated in the roots, and the Sr to Ca ratio became progressively lower in the stems, petioles, and leaves.

Mortensen, J. L., and Martin, W. P. EFFECT OF SOIL-CONDITIONER-FERTILIZER INTERACTIONS ON SOIL STRUCTURE, PLANT GROWTH, AND YIELD. Soil Sci. 81: 33-46. 1956.

Field application of the synthetic polyelectrolytes HPAN and VAMA markedly influenced the physical properties of Hoytville silty clay as evidenced by a significant increase in aggregate stability and aeration porosity. Although conditioner-treated plots appeared to dry out more rapidly after rainstorms, the field-moisture percentage, water-holding capacity, and moisture equivalent were not altered by either conditioner or fertilizer treatment. Cation-exchange capacity and pH were not altered by treatment.

Throughout a second growing season, improved soil structure and stability of aggregates as a result of conditioner treatment were significantly maintained. Aggregation values for all plots, treated and untreated, were about 10 percent less than the values obtained 1 year previously.

Mortland, M. M. ADSORPTION OF AMMONIA BY CLAYS AND MUCK. Soil Sci. 80: 11-18. 1955.

Studies were made on the characteristics of the adsorption isotherms of ammonia by such adsorbents as Wyoming bentonite, kaolinite, and muck. The muck adsorbed the most ammonia, and kaolinite the least. Hydrogen-saturated bentonite adsorbed more ammonia than did that saturated with Ca. Sodium saturation resulted in least adsorption by the bentonite. Heat of adsorption (ΔH) calculated from the Clausius-Clapeyron equation showed the surface adsorption sites of Wyoming bentonite to be markedly heterogeneous, since the energy of adsorption varied according to the amount of surface covered with ammonia. The heat of adsorption (ΔH) was high, indicating a strong bond between the ammonia and clay surface. The heat of adsorption (E_1) calculated from the Brunauer, Emmett, and Teller equation varied little with the nature of the adsorbent.

Mulvehill, J. F., and MacGregor, J. M. THE EFFECT OF SOME TRACE ELEMENTS ON THE YIELD AND COMPOSITION OF ALFALFA AND OATS IN MINNESOTA. Soil Sci. Soc. Amer. Proc. 19: 204-207. 1955.

Applications of soluble B, Mn, Zn, and Cu to the soil of 13 experimental fields on several important soil types produced no significant effect on the yield of either alfalfa or of oats. However, the first cutting yield of one field of an alfalfa-grass mixture was significantly increased by applying boron.

The water soluble (available) B was largely concentrated in the surface 6 inches of soil, with the 12-24-inch depth averaging less than half as much soluble B. None of the experimental field soils was alkaline. One soil in east central Minnesota approached the critical level of soluble B content. The soils of this area are known to be boron deficient for rutabaga production.

There was little positive correlation between the soluble B content of the soil and total B in oat grain. Applying B at three rates significantly increased the B content of oat grain, but not in either alfalfa or alfalfa-grass mixtures.

Munson, R. D., and Stanford, G. PREDICTING NITROGEN FERTILIZER NEEDS OF IOWA SOILS: IV. EVALUATION OF NITRATE PRODUCTION AS A CRITERION OF NITROGEN AVAILABILITY. Soil Sci. Soc. Amer. Proc. 19: 464-468. 1955.

This study, conducted under controlled greenhouse conditions, was designed to evaluate critically the utility of soil nitrate release as a basis for establishing the relative N status of soils. The 21 soils used in this investigation represent a wide range in N-supplying capacity. Four levels of N fertilizer were applied to pots and German millett was grown.

The relation between total N uptake by the crop and level of applied N was linear for all soils studied. Extra-polation of the linear regressions provided values which reflected the relative contents of available N in the soils. These values which have been termed N-values are expressed in units of applied N. Also, N-values correlated highly with the total N uptake of the check pots. Both N-values and N uptake by the plants were highly correlated with nitrate N released during 2 weeks of incubation. Considerably lower correlations were found in relating these criteria to total soil N or to values obtained by the alkaline permanganate method.

Murdock, J. T., and Seay, W. A. THE AVAILABILITY TO GREENHOUSE CROPS OF ROCK PHOSPHATE PHOSPHORUS AND CALCIUM IN SUPERPHOSPHATE-ROCK PHOSPHATE MIXTURES. Soil Sci. Soc. Amer. Proc. 19: 199-203. 1955.

Two experiments were designed to test the effects of plant species, rates of fertilizer application, and superphosphate-rock phosphate mixtures on the availability of rock phosphate. Vigo wheat and Kenland red clover were grown for 3 months on Pearman silt loam and the above-soil-portion of the plants used for analyses. The availability of rock phosphate P was measured by plant yields, P content of plants, and uptake of P^{32} from irradiated rock phosphate and radioactive superphosphate.

The following are conclusions: (1) Clover is a better feeder on rock phosphate P than is wheat; (2) the amount of available rock phosphate P is increased by increasing the rate of application; (3) about three and one half to four times as much rock phosphate P_2O_5 as superphosphate P_2O_5 is needed to give equal yield and plant P contents when the P sources are applied separately; (4) small application of superphosphate applied with relatively large amounts of rock phosphate increases the uptake of rock phosphate P but when superphosphate and rock phosphate are applied together in equal quantities the uptake of rock phosphate P is decreased; (5) rock phosphate is of value as a fertilizer filler in increasing crop P content and yields as well as for use as a conditioner; and (6) phosphorus is taken up more readily from irradiated rock phosphate by clover and wheat than is calcium.

Nelson, L. B., and Uhland, R. E. FACTORS THAT INFLUENCE LOSS OF FALL APPLIED FERTILIZERS AND THEIR PROBABLE IMPORTANCE IN DIFFERENT SECTIONS OF THE UNITED STATES. Soil Sci. Soc. Amer. Proc. 19: 492-496. 1955.

The purpose of this paper was to reconcile observed differences in effectiveness of fall vs. spring applied fertilizers between states, and to point out factors that influence loss of fall applied fertilizers and their probable importance in different parts of the United States. Particular emphasis is placed on N fertilizers.

Possibilities for leaching losses from fall applied fertilizers were evaluated from the standpoint of percolation of water from the soil in various areas and temperatures as they relate to conversion of ammonia-nitrogen in fertilizers to leachable nitrate forms. On this basis, it appears that leaching losses would be negligible in the Plains States and parts of Minnesota and Iowa. Progressing eastward, leaching from most soils is likely to increase, and fall applied N becomes questionable. In the South, where high percolation and temperatures predominate, fall application appears inadvisable.

Nelson, L. G., Berger, K. C., and Andries, H. J. COPPER REQUIREMENTS AND DEFICIENCY SYMPTOMS OF A NUMBER OF FIELD AND VEGETABLE CROPS. Soil Sci. Amer. Proc. 20: 69-72. 1956.

A number of field and vegetable crops were grown in the field and greenhouse on a peat soil very deficient in Cu. Yield responses and Cu contents of the plants were determined and Cu-deficiency symptoms photographed and described.

In another series of tests the need for Cu by oats on several upland soils was determined, and data concerning yield and Cu content of the oats are presented. Significant increases in yields of straw were obtained in several cases.

In the tests on the peat soil, oats showed the greatest need for Cu among field crops and red beets among vegetable crops. Oat yields without

Cu were slightly over 1 bushel per acre, and with Cu 64 bushels. Red beet yields were increased fivefold by the application of Cu to this soil. Copper contents of plants varied considerably and in general increased with Cu fertilization.

Olson, R. A., and Dreier, A. F. FERTILIZER PLACEMENT FOR SMALL GRAINS IN RELATION TO CROP STAND AND NUTRIENT EFFICIENCY IN NEBRASKA. Soil Sci. Soc. Amer. Proc. 20: 19-24. 1956.

Investigations in the field and constant temperature laboratory suggest a low moisture level at which the most serious damage of fertilizer salts to germination occurs, but full germination is not assured at any soil-moisture level without a surface increment to leach fertilizer away from the seed. Emergence loss from N adjacent to the seed at low moisture level is in direct proportion to the time interval before rain or irrigation raises the level. In general, N materials are more detrimental per unit weight than K, and the latter more than P. Damage to germination under critical soil moisture is apparent at 10 lbs. N/acre, increasing to the point of stand elimination with 160 lbs. N/acre. Among N carriers, $CaCN_2$ and NH_4OH are most deleterious to germination followed by $CO(NH_2)_2 > NaNO_3 > KNO_3 > (NH_4)_2SO_4 > NH_4NO_3$. Straight carriers of phosphate cause little damage, but ammonium phosphates of 1:1:0 ratio are harmful when placed with the seed under conditions of limited moisture; the damage is less with pelleted than finely ground material. Fertilizer and seed need not be in immediate contact for germination inhibition, as evidenced by appreciable migration of N and P to the imbibing seed.

Phosphorus placement with the seed of small grains is desirable in the drier regions so long as the N concurrently added with the seed does not exceed 10 or 15 lbs./acre. Supplementary N is essential to maximum P fertilizer utilization, but much of it should be applied separate from the seed.

Owens, L., Lawton, K., Robertson, L. S., and Apostolakis, G. LABORATORY, GREENHOUSE, AND FIELD STUDIES WITH MIXED FERTILIZERS VARYING IN WATER-SOLUBLE PHOSPHORUS CONTENT AND PARTICLE SIZE. Soil Sci. Soc. Amer. Proc. 19: 315-319. 1955.

Greenhouse and field studies were undertaken in Michigan to evaluate the effect of the water-soluble P content and particle size of mixed fertilizers on the availability of fertilizer P to plants. Supplementary laboratory experiments were conducted to study the behavior of P in granulated mixed fertilizers under various soil conditions.

The rate at which the water-soluble fraction, of P moved out of fertilizer granules was rapid, essentially being complete in 48 hours. No important difference in dissolution rate was noted for fertilizers with varying water-soluble P contents over the range of 3.3 to 15-percent moisture. The extent of movement of fertilizer P away from large granules and the concentration in soil around the phosphate was directly related to the percentage of water-soluble P in the fertilizer.

Varying the water-solubility of phosphate fertilizer having a similar $N\text{-}P_2O_5\text{-}K_2O$ ratio had no significant effect on dry weight yield of wheat plants grown in the greenhouse. The percentage of plant P derived from fertilizer was markedly influenced by the water-soluble P content and the particle size of the mixed fertilizer and soil reaction.

Rich, P. A., and Dudley, D. I. GRAIN SORGHUM FERTILITY TRIAL AT DENTON, 1955. Tex. Agr. Expt. Sta. Prog. Rpt. 1844. February, 1956.

A hybrid grain sorghum fertility experiment was conducted in 1955 on San Saba clay at Denton.

Sixty pounds of N significantly increased grain yields.

One hundred and twenty pounds of N did not cause a further increase over that from 60 pounds of N.

Phosphorus and potash alone or in any combination did not affect yields.

Rapp, H. F., and Hardesty, J. O. STORAGE AND DRILLING CHARACTERISTICS OF HIGH-ALUMINA NITRIC PHOSPHATE PREPARED FROM FLORIDA LEACHED-ZONE ORE. Agr. and Food Chem. 3: 1026-1028. 1955.

In current practice leached-zone phosphate material is discarded in Florida land-pebble mining operations. A possible use of this waste material is in the manufacture of high-alumina fertilizers with nitric acid treatment. To provide information on the storage and drilling characteristics of fertilizers produced in this manner, tests were made on two lots of experimental material produced by the Tennessee Valley Authority. Bag-storage properties were very good and drilling properties superior to nitric phosphates made from high grade land pebble previously tested. The results indicate that fertilizers of good physical quality can be prepared from the leached-zone ore.

Reid, P. H., and York, E. T., Jr. THE RELATIVE GROWTH AND POTASSIUM ABSORPTION BY FOUR CROPS UNDER INTENSIVE CULTURE IN A LIMITED VOLUME OF SOIL. Soil Sci. Soc. Amer. Proc. 19: 481-483. 1955.

Two successive crops of peanuts, soybeans, corn, and cotton were grown in small volumes of Ruston fine sandy loam to study the relative efficiencies of the 4 crops to absorb K in a limited root environment. One series of treatments was fertilized and another unfertilized with respect to K. The roots of all 4 crops thoroughly per-

meated the soil, providing conditions for the rapid exhaustion of readily available sources of K.

All crops except cotton absorbed essentially the same amount of K under high levels of fertilization; however, cotton tended to absorb slightly more K than the other crops under low K conditions.

Potassium deficiency symptoms appeared first and were most severe on corn, followed by cotton, soybeans, and peanuts in that order.

Rubins, E. J. MOLYBDENUM STATUS OF SOME UNCULTIVATED CONNECTICUT SOILS. Soil Sci. Soc. Amer. Proc. 19: 207-209. 1955.

The Mo status of 6 uncultivated Connecticut soils was studied in the greenhouse using lettuce and subterranean clover as test crops. Treatment effects were evaluated by visual appearance of the plants and by determining dry weight and nitrate content of the tops.

Lettuce responded markedly to Mo applications on 4 of the soils at light rates of lime. Lettuce on another soil responded to Mo in terms of greater growth and lowered nitrate content of the tissue but no foliar differences were observed. Growth of lettuce on the sixth soil was depressed by Mo applications in early stages, and the concentration of nitrate in the tissue at harvest was not lowered. Lettuce did not respond to Mo at heavier rates of lime on the 3 soils for which this information was obtained. On all 3 of these soils, the effect of heavier lime alone was greater than that of Mo at the lower rate of lime.

Subterranean clover did not respond to Mo at light rates of lime or any of the 4 soils on which this crop was grown. Analysis of the clover tops for Mo indicated that more than 80 percent came from sources other than the seed on control cultures.

Salomon, M., and Smith, J. B. RESIDUAL SOIL PHOSPHORUS FROM VARIOUS FERTILIZER PHOSPHATES EXTRACTED BY DIFFERENT SOLVENTS. Soil Sci. Amer. Proc. 20: 33-36. 1956.

A Bridgehampton silt loam of moderate acidity which had received phosphate from several sources for 48 years followed by 10 years without additional phosphates was analyzed for extractable P by 8 methods. Phosphorus from superphosphate, rock phosphate, Thomas slag, and ground bone, determined by these chemical tests, was correlated with yields of hay, P uptake, yields of sudangrass, and total soil P.

Methods using relatively strong acid extracting solutions (Bray's 0.1 HCl + 0.03 N NH_4F and Thornton's 0.1 NHCl + $(NH_4)_2$ MoO_4) and those employing weaker acids with wide soil-extracting solution ratios (Peech's CH_3COOH + $NaC_2H_3O_2$ and Truog's 0.002 N H_2SO_4 + $(NH_4)_2$ SO_4) gave the most consistent positive correlations. Bray's weaker acid solution (0.025N HCl) distinguished soils receiving rock phosphate from those receiving P from superphosphate. Alkaline extractants (NaOH and $NaHCO_3$) and Morgan's extracting solution ($NaC_2H_3O_2$ + CH_3COOH) proved least adapted to the soil tested. The Peech and Truog methods, although inconvenient for quick soil tests, gave a better indication in terms of probable crop response to P than did the Bray (P_2) method which, although it reflected the P status of the soil very well, extracted excessive quantities when compared to the levels of low, medium, and high P proposed by Bray as a guide for fertilizer recommendations. The Thornton method extracted somewhat more P than had been previously established at this station for use in making recommendations based upon rapid soil tests.

Total P accumulation due to treatment was greatest in the rock phosphate plots and least where triple superphosphate had been added. Residual effects from superphosphate, Thomas slag, and ground bone were intermediate.

Schmehl, W. R., Olsen, S. R., Gander, R., Romsdal, S. D., and Kunkel, R. AVAILABILITY OF PHOSPHATE FERTILIZER MATERIALS IN CALCAREOUS SOILS IN COLORADO. Colo. Agri. Expt. Sta. Tech. Bul. 58. 1955.

Field experiments were conducted with four crops on irrigated soils of Colorado to determine the availability of the P sources as affected by method and rate of fertilizer application. The crops were sugar beets, barley, alfalfa, and potatoes. Results showed that the relative availability of phosphate sources may depend upon such variables as method of fertilizer application, moisture supply, crop, soil properties, fertilizer characteristics, and possibly others. Therefore, it becomes necessary to consider all factors before stating the relative fertilizer value of phosphate sources. The most efficient use of each fertilizer material is discussed. The residual value of phosphate sources was also studied.

Seay, W. A., and Weeks, M. E. THE EFFECT OF TIME OF TOP-DRESSING ON UPTAKE OF PHOSPHORUS AND POTASSIUM BY AN ESTABLISHED STAND OF ALFALFA. Soil Sci. Soc. Amer. Proc. 19: 458-461. 1955.

Plots of established alfalfa were topdressed with radioactive superphosphate and half the plots received potash. Topdressing dates varied from September to the following June. Entire plants were sampled at various periods after topdressing and divided into tops, crowns, and roots for analyses.

Conclusions were (1) P and K are translocated to crowns from roots and tops during autumn, (2) topdressed P is taken up by alfalfa even in the winter or dormant season, (3) in spring a rapid translocation of P and K from roots and crowns to tops occurs, (4) K fertilization does not affect P uptake from soil by alfalfa, (5) P fertilization does not significantly affect K uptake from soil by alfalfa although trends are more suggestive

than the effect of K fertilization on P uptake, and (6) topdressed P was taken up to a greater extent from Hagerstown silt loam than from Nicholson silt loam which was expected in that chemical soil tests showed more available P in the Nicholson.

Stanberry, C. O., Converse, C. D., Haise, H. R., and Kelley, O. J. EFFECT OF MOISTURE AND PHOSPHATE VARIABLES ON ALFALFA HAY PRODUCTION. Soil Sci. Soc. Amer. Proc. 19: 303-310. 1955.

Alfalfa was grown on Superstition loamy fine sand on the Yuma Mesa for 4 years, 1949-52, to evaluate the effects of moisture and phosphate variables on hay production and associated factors. The 3 moisture treatments were based on tension levels, tensiometers being installed at 9 depths from 6 to 120 inches. A total of about 125,000 tensiometer readings were recorded during the 4 years. Ten phosphate (superphosphate) rates and/or frequencies ranging from 100 to 1,300 pounds P_2O_5 for the 4 years were employed as subplots in the split plot design.

Average annual hay yields for the 4 years ranged from 6.4 to 12.3 tons per acre, being greatly affected by either moisture or P level. Small frequent irrigations and an initial fertilizer application of more than 200 pounds P_2O_5 plus 100 pounds of P_2O_5 annually appeared to be the goals to approach. Phosphorus movement was largely limited to the surface 18 inches which was less than expected. As measured by tensiometers the depth for the greatest relative activity of roots decreased with decreasing moisture tension, increased with decreasing supplemental phosphate, and increased with increasing temperatures.

Soil sampling for 32 months revealed that for "dry," "medium," and "wet" treatments, respectively, 80, 74, and 27 percent of the available moisture and 72, 82, and 85 percent of the total water utilized by the plant were removed from the surface 48 inches of soil. For 3 years the mean water use per day ranged from 0.21 to 0.25 inch, the greatest amount being used in the wet or low-tension treatment. Water used per ton of hay produced ranged from 7.1 to 16.5 inches, high rates of moisture and phosphate giving greatest efficiency.

Starostka, R. W., Armiger, W. H., and Hill, W. L. COMPARISON OF PHOSPHATE FERTILIZERS--FERTILIZER VALUE OF CALCINED AND FUSED PHOSPHATES ON TYPICAL SOILS. Agr. and Food Chem. 3: 765-771. 1955.

A greenhouse experiment was performed to compare four 200-mesh, single-step thermal process phosphates with triple superphosphate and phosphate rock as sources of P for alfalfa and rye grass on 10 typical soils of the United States. Rhenania phosphate, Coronet phosphate, and phosphate rock-Mg silicate glass had nutritive values about equal to that of superphosphate when applied to calcareous soils of the Western United States, while fused tricalcium phosphate had a lower nutritive value. Response to P application was low on these soils. The furnace phosphates and superphosphate gave comparable results with alfalfa on the Midwestern, Southeastern, and Mississippi blackbelt soils; with rye grass, Rhenania phosphate gave a lower nutritive response than the other materials. Phosphate rock showed little or no response over the no-phosphorus treatment on all the soils.

Starostka, R. W., and Clark, K. G. GREENHOUSE EVALUATION AND NITRIFICATION CHARACTERISTICS OF BIURET AND UREA-BIURET MIXTURES. Agr. Chem. October 1955.

The results of a ryegrass experiment conducted during the winter months showed that biuret injured the crop for a short period after application. After having been in the soil for several weeks, it was a useful source of N for the crop. Another experiment with corn, cotton, tomatoes, and oats during the summer showed that a 100 lb. N per acre application of a 9:1 urea-biuret mixture to the soil did not harm the plants. In laboratory tests at 30°C. the rate of nitrification of biuret was substantially lower than that of either ammonium sulfate or urea but the degree of nitrification of all three materials was substantially the same at the end of 15 weeks. These results tend to substantiate the observations made on the ryegrass experiment.

Starostka, R. W., and Hill, W. L. INFLUENCE OF SOLUBLE SALTS ON THE SOLUBILITY OF AND PLANT RESPONSE TO DICALCIUM PHOSPHATE. Soil Sci. Soc. Amer. Proc. 19: 193-198. 1955.

Alfalfa was used as the test crop on Nunn, Carrington, and Chester soils. In general, salts such as ammonium sulfate, which in laboratory tests markedly increase the solubility of dicalcium phosphate with increasing ionic strength, also gave the greatest crop responses in the greenhouse. Those salts such as the ammonium nitrate type, which increase the solubility only moderately and level off at ionic strengths between 2 and 4, only occasionally gave increased crop response, while salts such as the Ca nitrate type, which decrease the solubility sharply with increasing ionic strengths, usually gave a negative crop response.

Starostka, R. W., Norland, M. A., and MacBride, J. E. NUTRITIVE VALUE OF NITRIC PHOSPHATES PRODUCED FROM FLORIDA LEACHED-ZONE AND LAND-PEBBLE PHOSPHATES DETERMINED IN GREENHOUSE CULTURE. Agr. and Food Chem. 3: 1022-1025. 1955.

Processes for producing nitric phosphate offer a means for utilizing low grade phosphate mate-

rial, called leached-zone ore, that occurs in Florida land-pebble deposits. Because the nitric phosphate produced therefrom carries a much larger amount of Al than that made from commercial Florida land pebble, nutritive tests were made in the greenhouse, to determine the relative value of the high-alumina nitric phosphate. Crop yields and P uptakes showed that the leached-zone nitric phosphate had a lower agronomic value than the land-pebble material, when both had a low proportion of P in the water-soluble form. At medium levels of water solubilities, however, both products and triple superphosphate gave comparable yields.

Struchtemeyer, R. A., Cunningham, C. E., and Carpenter, P. N. UTILIZATION OF RESIDUAL FERTILITY BY POTATOES. Soil Sci. Soc. Amer. Proc. 19: 212-214. 1955.

Inherently the soils of Maine do not possess a high natural fertility. Analyses of virgin samples show that such soils contain about 5 percent of organic matter, 44 pounds of readily soluble P_2O_5 per acre, and 76 pounds of exchangeable K_2O per acre and have pH reading ranging from 4.5 to 5.0. As a result of intensive fertilization over a period of years the amount of P_2O_5 per acre has increased to about 100 pounds per acre, and the amount of K_2O has increased to about 200 pounds per acre.

The Katahdin variety of potatoes was grown. The fertilizer applications were 2,000 pounds of each of the following fertilizers: 6-0-0, 6-9-0, 6-0-9, and 6-9-9. The fertilizer was applied each time the plot was in potatoes. The yield results showed that dropping P out of the fertilizer significantly decreased the yields in all cases. In 1951 the elimination of K did not significantly reduce the yield. In 1952 the elimination of K did cause a significant decrease in yield. It would appear that potatoes can mine the K reserves in the soil more efficiently than the P reserves.

The Fertilizer Work Group. FERTILIZER USE AND CROP YIELDS. U. S. Dept. Agr. Handbook 68. 1954.

This handbook is the result of studies conducted by the National Fertilizer Work Group, appointed in March 1951. During that year 4 regional reports analyzing crop production potentials in relation to the use of fertilizers were prepared. These were followed by a 5th report summarizing the data on a national basis. The 5 reports were then revised and combined into this report, which in final manuscript form was approved by each of the 48 cooperating State agricultural experiment stations for publication as a handbook by the Agricultural Research Service of the United States Department of Agriculture.

Trickey, N. G., and Smith, G. E. LOSSES OF NITROGEN FROM SOLUTION MATERIALS. Soil Sci. Soc. Amer. Proc. 19: 222-224. 1955.

The effect of temperature, soil moisture, and methods of application on the loss of ammonia from solutions of ammonium nitrate and ammonia in water have been measured in the laboratory and by wheat yields in the field. The loss of ammonia was increased as soil moisture was lowered and temperatures were raised. Losses were less when applied on soil than on crop residues. These solutions gave increases in wheat yields equivalent to solid forms of N when applied under the surface of the ground.

van't Woudt, B. D. SOIL MOISTURE AND FERTILITY EFFECTS ON CLOVER YIELD. Soil Sci. 80: 1-9. 1955.

The general increase in pasture productivity from the top to the foot of slopes in the pumice country was examined on a representative experimental area. Soil analytical features could partly explain the increase in productivity, but results from a pot experiment with subterranean clover indicated that an increase in prevalent soil-moisture level with descent on the slope substantially contributed to the establishment of the productivity gradient.

Volk, G. M. EFFICIENCY OF VARIOUS NITROGEN SOURCES FOR PASTURE GRASSES IN LARGE LYSIMETERS OF LAKELAND FINE SAND. Soil Sci. Amer. Proc. 20: 41-45. 1956.

A 3-year study of the efficiency of various amounts and sources of N for Pensacola Bahia grass, Pangola grass, coastal bermudagrass, and carpetgrass was made in 12 lysimeters about 22 square feet in area and 4 feet deep filled with Lakeland fine sand. There was no consistent difference in yield or N content of forage when three 20-pound applications of N were derived from urea, NH_4NO_3, or $NaNO_3$, nor between urea and NH_4NO_3 when applied at 60 pounds of N per month for 6 or 8 months.

Leaching loss of N generally was low even for the high N applications, except in the case of carpetgrass. Percentage recovery of N in the forage ranged from 50 to 80 percent depending on the amount applied and the vigor of the grass. Leaching losses were not a major factor in accounting for the lack of recovery of N in the forage.

The pH of the 0- to 10-inch surface soil was lower, and that of the 10- to 18-inch subsoil higher at the end of the study than it had been at the time the lysimeters were filled. The pH of the entire 0- to 18-inch depth was consistently lower where NH_4NO_3 had been used as compared to urea.

Welch, C. D., and Fitts, J. W. SOME FACTORS AFFECTING SOIL SAMPLING. Soil Sci. Amer. Proc. 20: 54-56. 1956.

A study was conducted to obtain information as to the effects of tools used and depth of sampling on results of soil analysis. All samples were analyzed for pH, P, K, and organic matter. Some of the principle findings were as follows:

There was no significant difference between results of analysis for samples collected with a tube, spade, or trowel. The pH and organic-matter values were significantly lower for samples collected with the auger as compared to the other tools. There was no significant difference between analyses for duplicate samples collected in a bucket.

There was a significant decrease in the pH of soil with depth from the 0 to 3 to the 6 to 9 inch layers of soil in fields seeded to sod crops. The difference was not significant for comparable fields used for row crops. The amount of P, K and organic matter decreased with depth in fields used for sod crops as well as those in row crops.

The soil analyses results for pH, P, and K and organic matter were significantly lower for samples composited from 0- to 6-inch cores as compared to 0- to 3-inch cores for fields in sod crops in the Coastal Plains as well as for those in the Piedmont and Mountains. Samples from 0- to 6-inch cores in fields used for row crops showed significantly lower results than those from 0 to 3 inches for pH, K, and organic matter in the Piedmont and Mountains but only for organic matter in the Coastal Plains.

Whittaker, C. W., Armiger, W. H., Chichilo, P. P., and Hoffman, W. M. "BROWN MUD" FROM THE ALUMINUM INDUSTRY AS A SOIL LIMING MATERIAL. Soil Sci. Soc. Amer. Proc. 19: 288-292. 1955.

"Brown mud" is a siliceous waste product resulting from the extraction of alumina from bauxite. Present production is estimated to exceed half a million tons annually, the disposal of which is a problem in the industry. When dry, the mud contains about SiO_2 23, CaO 47, Fe_2O_3 10, TiO_2 3.5, Al_2O_3 5.5, and Na_2O 3.6 percent, and small amounts of other elements.

In a greenhouse study with sweetclover as the indicator crop, using acid Evesboro and Chester soils, the dried brown mud produced yields substantially equal to those obtained with equivalent amounts of other liming materials. Emergence counts and appearance of the crop gave no indications of any toxic effects from the use of the mud. The mud increased soil pH to values that were usually equal to or exceeding those produced by finely divided agricultural limestone and were sometimes equal to those produced with hydrated lime. The Ca concentration in the dried plant material increased as the liming rate increased in about the same manner with the mud as with the other liming materials. As might be expected, the Na content of the crop tended to be higher where the mud was used. The K content of the crop was reduced to a greater extent by the mud than by either hydrated lime or limestone: this effect was probably also due to the Na content of the mud. The data indicate that the dried mud is a satisfactory liming material.

Willcox, O. W. AGROBIOLOGIC PERCENTAGE METHOD OF EVALUATING FERTILIZER TESTS: II. PHOSPHATE AND OATS: MIXED FERTILIZER AND POTATOES. Soil Sci. 80: 75-83. 1955.

Four general categories that occur in field testing with fertilizers are named and defined.

An example from practice is cited to show how the standard yield diagram is used to identify certain soils as affected by near-end yield depression, and how the results of application of phosphate to these soils are interpreted by the percentage method.

Another example, which also involves a case of near-end depression, is adduced as a demonstration of the principle of reproducibility.

Willcox, O. W. AGROBIOLOGIC PERCENTAGE METHOD OF EVALUATING FERTILIZER TESTS: III. QUANTITATIVE AGROBIOLOGIC ANALYSIS OF A FACTORIAL EXPERIMENT. Soil Sci. 81: 57-69. 1956.

The author shows that a variance analysis of the results of field tests with fertilizers does not supply the operator with any real information on the situations on his test field. Such tests are made to determine whether use of fertilizers would improve the yields of useful plants and by how much. The most a statistician who uses this method can offer is an abstract figure called, "least significant difference," that is supposed to measure the reliability of experimentally found differences. But in specific cases these least differences may be grossly misleading.

This defect of the variance method arises from the fact that the method, being abstract, has no concrete base in the specific nature of either plots or fertilizers, which are under the exclusive control of a general law of the "vegetable kingdom," the law of diminishing increments of a yield, which is known to apply to every species of rooted and green-leaved plant that has yet come under quantitative study.

Woodhouse, W. W., Jr. EFFECT OF PLACEMENT AND RATE OF PHOSPHATE, POTASH, AND LIMESTONE ON THE GROWTH OF ALFALFA AND LESPEDEZA. Soil Sci. Soc. Amer. Proc. 20: 15-18. 1956.

Placements at 2 rates each of phosphate, potash, and limestone were compared on 2 legume-grass mixtures for 3 years. The placements were surface, plow sole, and mixed with the plow layer. The mixtures were alfalfa-orchardgrass and Kobe lespedeza-Dallis grass. Lime

placement effects on the alfalfa-orchardgrass mixture were very pronounced. The surface application was least effective and mixing with the plow layer was the most favorable placement. Surface placement of phosphate was inferior to the other two placements the first year while placement of potash had no effect. Placement of phosphate, potash, or lime did not measurably affect growth of the lespedeza-Dallis grass mixture.

Structure Control

Allison, L. E. SOIL AND PLANT RESPONSES TO VAMA AND HPAN SOIL CONDITIONERS IN THE PRESENCE OF HIGH EXCHANGEABLE SODIUM. Soil Sci. Soc. Amer. Proc. 20: 147-151. 1956.

Two field experiments with the polyelectrolyte soil conditioners, VAMA and HPAN, were conducted to determine their effect on an irrigated soil-Pachappa loam-having a high content of exchangeable Na. The 2 conditioners were applied, at the 0.1-percent rate to a depth of 6 inches, with sufficient mixing to insure thorough incorporation with soil. Sweet corn was used as the test crop. The initial study was started in 1951 and continued for 4 cropping seasons. Treatment of high-Na plots with VAMA in solution gave a large increase of aggregates larger than 0.10 mm. diameter, gave up to tenfold increases in infiltration rate, and greatly reduced modulus of rupture values which resulted in increased emergence and stand of crops. Increases in yield of sweet corn were obtained as a result of soil physical improvement. For the 4 annual crops, the average yield increases due to treatment were 75, 200, and 260 percent on 3 plots having initial exchangeable-Na percentages of 29, 40, and 47, respectively. In a second and larger experiment begun in 1952, the VAMA and HPAN type of polyelectrolytes (100-percent active) and their respective clay formulations (25-percent active) were thoroughly incorporated as a dry treatment into moist soil. For high-Na Pachappa loam soil and at the rates of application used, there appeared to be little or no difference in performance between the 2 types of conditioners or between formulations for a given type. Soil and crop responses due to treatment were similar to those obtained in the first experiment. Sodium removal from the top 6 inches of soil, as a result of irrigation, was about twice as rapid on plots treated with conditioner as for plots not so treated. In the second experiment, the effect of the conditioner treatment in facilitating Na removal was equivalent to a 2-ton application of gypsum.

Allison, L. E., and Moore, D. C. EFFECT OF VAMA AND HPAN SOIL CONDITIONERS ON AGGREGATION, SURFACE CRUSTING, AND MOISTURE RETENTION IN ALKALI SOILS. Soil Sci. Soc. Amer. Proc. 20: 143-146. 1956.

A laboratory study was made to determine the relative effectiveness of VAMA and HPAN polymers at 6 rates of application in producing high water-stable aggregation. Nine alkali soils and 2 nonalkali soils, obtained from experimental sites in 6 Western States, were used in this investigation. VAMA conditioner proved appreciably more effective than HPAN conditioner, within the rates of application of 0.025 to .20 percent, for 8 of the 11 soils studied. For 3 soils, there appeared to be no significant difference between these 2 kinds of conditioners at any of the rates used. The rate of application of polymers necessary for effective structure stabilization was directly related to both the specific surface and the clay content of soil. Because of its simplicity, the determination of clay content by any satisfactory method is recommended as a guide to rate of polymer treatment for maximum aggregation. As determined by modulus of rupture measurements, both types of conditioners were effective in ameliorating soil hardness, or the crusting tendency, of high-Na soils. However, neither conditioner exhibited an appreciable effect on soil-moisture retention.

Baird, B. L., Bonnemann, J. J., and Richards, A. W. THE USE OF CHEMICAL ADDITIVES TO CONTROL SOIL CRUSTING AND INCREASE EMERGENCE OF SUGAR BEET SEEDLINGS. Amer. Soc. Sugar Beet Tech. Proc. 8 (I): 136-142. 1954.

The value of chemical additives to increase the emergence of sugar-beet seedlings was studied in 5 field plot trials on the clay soils of western South Dakota.

Application was made by broadcasting the additives on the soil surface and incorporating them to various depths in 3 of the trials. Natural weather conditions were depended upon to produce a crust on the soil surface.

Additives were also applied as dilute water solutions, 0.3 percent, sprayed on the soil surface in 2 of the trials. A rather severe crust was produced by applying water with a garden hose.

An increase in emergence attributed to the additive treatment was obtained in 2 of the 3 trials in which natural weather conditions were depended upon to produce a crust. Although no increase in emergence was obtained by the relatively economical surface spray method of application, this method may be satisfactory with less severe crusting conditions. The effect of the additive on the soil was visibly apparent in all of the trials

Ghani, M. O., Husan, K. A., and Khan, M. F. A. EFFECT OF LIMING ON AGGREGATION: NONCAPILLARY PORE SPACE, AND PERMEABILITY OF A LATERITIC SOIL. Soil Sci. 80: 469-478. 1955.

Studies were made on the effect of liming on aggregation, permeability, and noncapillary pore space of a lateritic soil of Dacca. $CaCO_3$, $CaSO_4$, and MgO were used as the liming materials, each at rates of 2.5, 5.0, and 7.5 tons per acre. The

value of $CaCO_3$ as an aggregating material appeared to be very doubtful. $CaSO_4$ was a better aggregator than $CaCO_3$. MgO was more a depressing agent than an aggregator.

Lauritizen, C. W. SOIL STABILIZERS FOR SEEPAGE CONTROL IN IRRIGATION CANALS AND RESERVOIRS. Indus. and Engin. Chem. 47: 2245-2248. 1955.

Seepage losses from canals and reservoirs in irrigated lands are the source of much economic waste. These losses can be controlled by lining. Many types of linings have been used with varying degrees of effectiveness. The results of treating soil material with stabilizer AM 955 are presented. The possibility of employing this stabilizer to control seepage losses in irrigation canals and reservoirs is discussed.

Nichols, M. L., and Reaves, C. A. SOIL STRUCTURE AND CONSISTENCY IN TILLAGE IMPLEMENT DESIGN. Agr. Engin. 36: 517-520, 522. 1955.

From these studies and observations, it is concluded that to obtain reliable, consistent, and understandable results with different implements and soils it is necessary to precede and to supplement all tillage studies or tests of implements with physical measurements and studies of the soil material.

Strickling, E. RELATIONSHIP OF POROSITY TO WATER STABILITY IN BELTSVILLE SOIL AGGREGATES. Soil Sci. 80: 449-457. 1953.

Porosity, water stability, organic matter, and texture were determined on soil aggregates taken from 162 plots, half of which had been treated 2.5 years previously with 1,000 pounds of vinyl acetate maleic acid (VAMA) soil conditioner per acre. Sampling correlation showed no relationship between porosity and water stability of the aggregates. A partial correlation coefficient of -0.402 was calculated for the aggregates from the untreated plots. This means that with organic matter constant, increasing water stability was associated with increasing compactness of the soil aggregates. Soil aggregate porosity was associated with organic-matter content, water stability, and texture. The simple correlation-coefficient between porosity and silt was +0.794 and between porosity and sand -0.791.

Drainage

Bouwer, H., Zwerman, P. J., Gray, H. E., and Levine, G. DRAINAGE RESEARCH METHODS ON STONY SOILS. Agr. Engin. 36: 591-592. 1955.

Techniques are presented for measuring water-table elevations and ground-water pressures in stony soils. The selection of the auger-hole method as a suitable method for measuring soil permeability in situ for these soil conditions are discussed, and the technique for installing auger holes and for obtaining and processing the necessary field observations presented.

Musgrave, R. B., Zwerman, P. J., and Aldrich, S. R. PLOW-PLANTING OF CORN. Agr. Engin. 36: 593-591. 1955.

Savings on tillage operations by plow-planting corn as compared with conventional seedbed preparations for corn may amount to $10 or $12 per acre. On the basis of 4 years of observation, corn yields are not reduced. Stands are improved. Plow-planting gives better weed control, reduces root pruning, improves soil aeration, increases infiltrations, and decreases erosion.

Irrigation

Allmaras, R. R., and Gardner, C. O. SOIL SAMPLING FOR MOISTURE DETERMINATION IN IRRIGATION EXPERIMENTS. Agron. Jour. 48: 15-17. 1956.

An irrigation experiment was initiated in 1952 to study the effect of frequency and time of irrigation on corn production. The water use by corn was estimated for each plot from soil-sampling units taken at various places in the plot by means of a Veihmeyer tube. More than 1,200 such units were taken from plots receiving irrigations ranging from 0 to 6. The sources of variability contributing to the total variation were considered, and estimates of these components of variation were obtained from 40 analyses of variance of 1952 data. The results indicated that the sampling scheme could be altered to considerable advantage. Variation due to sampling on the ridge, shoulder, or furrow and that due to gravity flow of water down the row was negligible. Hence, a scheme was chosen for use in 1953 and 1954 which reduced the number of sampling units 50 percent yet resulting in an increase in efficiency of 10 percent in estimating mean feet of water in the soil of each treatment. Consequently, considerable time and money was saved as a result of this study.

Bernstein, L., MacKenzie, A. J., and Krantz, B. A. THE INTERACTION OF SALINITY AND PLANTING PRACTICE ON THE GERMINATION OF IRRIGATED ROW CROPS. Soil Sci. Soc. Amer. Proc. 19: 240-243. 1955.

The influence of bed shape, planting, and irrigation practice on the germination of row crops on a series of artificially salinized plots was determined at Riverside and Brawley, Calif. Three experiments were conducted, testing 4 bed types with a total of 8 crops. The salinity status of the soil in the plow layer prior to bedding-up may be used to predict the probable success of various planting practices. Flat-topped single row beds present the greatest salinity hazard since suffi-

cient salt may accumulate around the seed during irrigation to prevent emergence even if the electrical conductivity of the saturation extract at the time of planting is only in the order of two or three millimhos. Sloping beds present the least salinity hazard because salt is effectively carried away from the seed row by the advancing wetting-front and accumulates in the top of the bed. Mulched beds and double-row flat beds (lettuce beds) are intermediate in salinity hazard in that initial salinities of about 10 millimhos may be tolerated if certain precautions are taken.

Blaney, H. F. CONSUMPTIVE USE OF GROUND WATER BY PHREATOPHYTES AND HYDROPHYTES. De l'Association Internationale d'Hydrologie. Publication No. 37, pp. 53-62. Rome. Sept. 1954.

In many parts of the world the ground-water supply is exceedingly limited and the demands for water, already great, are constantly increasing through pumping for irrigation, industrial, and domestic purposes. When making an inventory of the water resources of a river basin, water consumed by phreatophytes (ground-water vegetation) such as cottonwoods, salt cedar (tamarisk), willows and salt grass growing in areas of high water table and along streams becomes of increasing importance as greater land areas are irrigated, especially during drought. Through the process of transpiration these plants discharge and waste large quantities of ground water into the atmosphere.

Research studies show that the rates of consumptive use (evapotranspiration) by phreatophytes is much greater than the use of water by most irrigated crops. This paper describes and presents the results of studies and measurements of the use of ground water by phreatophytes and hydrophytes in arid and semiarid areas of the United States, and describes a method of determining rates of water consumption in areas where no measurements except climatological data are available.

Blaney, H. F. EVAPO-TRANSPIRATION MEASUREMENTS IN WESTERN UNITED STATES. De l'Association Internationale d'Hydrologie Publication No. 38, pp. 150-160, Rome.

This paper describes field methods for determining water use and presents results of measurements of evapotranspiration by irrigated crops and natural vegetation in Western United States. It describes a method for determining evapotranspiration in areas where no measurements are available. Briefly, the procedure is to correlate existing evapotranspiration data with monthly temperature, monthly percentages of yearly daytime hours, and growing period. The coefficients so developed for different kinds of vegetation are used to transpose the evapotranspiration data for a given area to other areas for which only climatological data are available by means of a formula, U = KF, where U = consumptive use (or evapotranspiration) for a period; K = empirical coefficient; and F = consumptive use factor.

Blaney, H. F., and Corey, G. L. EVAPORATION FROM WATER SURFACES IN CALIFORNIA. St. California Dept. Pub. Works Bulletin No. 54-B, Div. Water Resources. October 1955.

This report presents evaporation records in California from 1946 to 1955. The tabulations include heretofore unpublished data obtained from public and private agencies as well as records published monthly by the United States Weather Bureau.

Blaney, H. F., and Ewing, P. A. IRRIGATION PRACTICES AND CONSUMPTIVE USE OF WATER IN LAKE COUNTY, CALIFORNIA. U. S. Dept. Agr., ARS, Oct. 1955.

This report is a contribution to an investigation carried on by the Division of Water resources, California State Department of Public Works, involving the whole subject of the utilization of the water supply of the principal irrigated areas of Lake County. Estimated normal unit consumptive-use values for winter, summer, and unusual periods for irrigated crops, dry-farmed crops, native vegetation, and miscellaneous areas are summarized. The unit consumptive-use values may be applied to acreage to compute the total amount of water consumed for various areas in Lake County.

Blaney, H. F., and Muckel, D. C. EVAPORATION AND EVAPOTRANSPIRATION INVESTIGATIONS IN THE SAN FRANCISCO BAY AREA. Amer. Geophys. Union, Trans. 36: 813-820. 1955.

During 1953 and 1954 studies were made to determine probable evaporation and evapotranspiration losses that would occur if barriers were constructed across the San Francisco Bay to exclude salt water. This would create fresh-water pools to conserve water for irrigation, domestic, and industrial use. Available measurements of evaporation and consumptive use of water by vegetation were compiled and analyzed. New climatological stations were established in areas not covered by existing stations and measurements made on evaporation, temperature, humidity, wind movement, and precipitation. Evaporation and consumptive-use data were correlated with climatological records, and estimates were made of annual and monthly rates of evaporation from lake surfaces and consumptive use by marsh vegetation for 1921-52 and for the 5 critical years, 1923, 1924, 1930, 1931, and 1951.

Bonnen, C. A., McArthur, W. C., Magee, A. C., and Hughes, W. F. USE OF IRRIGATION WATER ON THE HIGH PLAINS. Tex. Agr. Expt. Sta. Bul. 756. 1952.

This bulletin presents data based on information obtained from an average of 154 farms and 203 irrigation wells from 1947 to 1949, and from 35 additional farms and their accompanying wells in 1949. The wide fluctuations in production and income on the High Plains have resulted largely from the highly variable and low average rainfall in the area. Irrigation has partly solved the problem. More than 2 million acres of cropland were under irrigation in 1952, with water coming from around 16,000 wells. The average amount of water used per acre of irrigated cropland in 1947-49 was about 11 acre-inches. Farms with low-yielding wells used less water per acre than those with high-yielding wells - 7.2 inches for wells yielding 500 gallons and less to 12.3 inches per acre for wells yielding more than 1,000 gallons. Acreage irrigated per well also fluctuated from season to season. During the 3 years, the average acreage irrigated per well was 121 on sandy soils and 151 on heavy soils. Cotton and sorghum are the chief crops irrigated, although some wheat and alfalfa are also grown under irrigation. Except for wheat, yields of crops commonly grown without irrigation were more than doubled when irrigated during the 3 years. Methods of spreading water vary with the crop and with the slope of the land and the texture of the soils. On most farms, water is carried to the fields by gravity through open earthen ditches.

Fox, R. L., Phelan, J. T., and Criddle, W. D. DESIGN OF SUBIRRIGATION SYSTEMS. Agr. Engin. 37: 103-107. 1956.

This report presents design features, requirements, advantages, and shortcomings of subirrigation.

Frost, K. R., and Schwalen, H. C. SPRINKLER EVAPORATION LOSSES. Agr. Engin. 36: 526-528. 1955.

A study of spray losses in sprinkler irrigation was undertaken to determine the percent of water reaching the ground or vegetative surfaces during application. Computed evaporation losses from the spray based upon the total exposed water surface as determined from droplet sizes were considerably lower than the experimental losses. It was believed that the wind drift and loss of the extremely fine droplets accounted for at least part of this difference.

Gray, H. E., Levine, G., and Kennedy, W. K. USE OF WATER BY PASTURE CROPS. Agr. Engin. 36: 529-531. 1955.

Results are presented on the consumptive use of water by irrigated pasture in a humid climate. The average daily consumptive use for the 1953 season was 0.13 inch per day. In 1954, it was 0.11 inch per day. The highest average daily consumptive use for any month was 0.16 inch in 1953 and 0.15 inch in 1954. The maximum average daily consumptive use for 10-days in 1953 was 0.20 inch. In 1954, it was 0.22 inch.

Harrold, L. L. EVAPOTRANSPIRATION RATES FOR VARIOUS CROPS. Agr. Engin. 36: 669-673. 1955.

Evapotranspiration rates for different crops vary notably throughout the growing season. Stage of development of vegetative cover of ground surface, availability of moisture for evapotranspiration, and fluctuation in climate appear to be major factors influencing evapotranspiration rates. Data from lysimeters and fiberglas-gypsum electrical-resistance blocks were used to develop evapotranspiration rates. These data showed that consumptive-use rates for alfalfa-timothy reached high values much earlier in the growing season than those for corn. Average peak-use rates for 10-day periods for corn exceeded the average monthly values by as much as 0.04 inch per day under normal rainfall conditions. With soil-moisture supplies maintained at high levels as under irrigation, the peak-use rates differed more noticeably from the average monthly values--as much as 0.14 inch per day.

Helfinstine, R., and Schaffner, L. W. IRRIGATION AND DRYLAND FARMING CAN WORK TOGETHER ON THE CANNONBALL RIVER. N. Dak. Agr. Expt. Sta. Bul. 385. 1953.

The study reported here was intended to analyze the probable effects of irrigation on ranch organization, capital requirements, and ranch costs and income, and to compare them with present dryland ranching. Other objectives were to point out some of the problems associated with shifting from dryland to a combination of irrigation and dryland ranching and to develop a method by which a rancher can evaluate the effects of irrigation on his own ranch. The study site was the proposed Cannonball River Irrigation Unit. Ranch budgets based on 1949 prices were prepared for a typical 1,120-acre ranch and a typical 3,200-acre ranch, each with and without irrigation. On the 1,120-acre ranch, 45 acres were developed for irrigation, and on the 3,200-acre ranch, 162 acres. Irrigation farming requires more seasonal labor than dry farming, and competes with summer operations in dry farming. The total ranch investment is higher on the partially irrigated ranch by as much as the cost of land development and the additional investment in livestock and machinery. The greatest benefit from irrigation in this area may be the stabilization of ranch income. Credit is frequently a problem in shifting from dryland to irrigation farming, but a rancher might sell some of his dry land to finance the cost of irrigation development.

Huff, F. A. STANDARD VERSUS SMALL-ORIFICE RAINGAGES. Agr. Engin. 37: 108. 1956.

Results of data analysis in which storm size and wind speed were taken into consideration indicate that the small-orifice gages are satisfactory for use in place of the standard 8-inch gage for measuring rainfall under most circumstances.

Hutchins. W. A. IRRIGATION WATER RIGHTS. Western Water News Suppl. January 1956.

Irrigation water rights in the Western States relate chiefly to surface watercourses--often referred to as streams--and to percolating ground waters. In legal parlance, percolating waters are distinguished from waters flowing in definite underground streams. In California, percolating waters include waters in artesian basins.

This discussion is confined chiefly to rights in surface streams and in percolating waters. Furthermore, the emphasis is upon California water rights. Unless specific mention of other States is made, it is implicit that the discussion relates to California.

Levine, G., Kennedy, W. K., and Gray, H. E. IRRIGATION OF PASTURES. Agr. Engin. 36: 471-473. 1955.

A method for using rotary sprinklers in small plot-irrigation experiments was tested and found to be satisfactory for forage crops. In addition to natural rainfall, 3 levels of supplemental irrigation were applied to uniform stands of alfalfa and bromegrass. The soil was a gravelly loam liberally fertilized with P and potash. Three N fertility treatments were studied under each of the 4 moisture levels.

Yield increases were the same for the 3 levels of supplemental irrigation and averaged 680 and 720 pounds of dry matter per acre during the summer months of 1953 and 1954, respectively. However, the spring production of 1954 was reduced by 550 pounds of dry matter per acre when the plots had been irrigated the previous summer. Thus, irrigation showed a net yield increase of only 850 pounds of dry matter per acre for 2 years.

Nitrogen fertilizer increased yields 760 and 1,200 pounds of dry matter per acre in 1953 and 1,170 and 2,430 pounds of dry matter per acre in 1954 for 100 and 200 pounds of N per acre, respectively.

Magee, A. C., Bonnen, C. A., McArthur, W. C., and Hughes, W. F. PRODUCTION PRACTICES FOR IRRIGATED CROPS ON THE HIGH PLAINS. Tex. Agr. Expt. Sta. Bul. 763. 1953.

Data for the study reported here were obtained from an average of 154 farms with 203 irrigation wells in 5 counties on the High Plains. The development of irrigation which has come about largely since the midthirties has increased emphasis on production of cash crops. Cotton, sorghum, wheat, and alfalfa are the chief crops irrigated. These crops used varying amounts of irrigation water. Spreading water, hoeing, and snapping of cotton required an average of 35 hours of man labor per acre. Seasonal workers did all the hoeing and hand harvesting. Other cotton operations were mechanized. In producing sorghum, spreading water required an average of 3.1 hours on sandy soil and 1.9 hours on heavy soil. Other operations were mechanized. Hand labor with wheat was entirely for irrigation; it averaged 1.2 hours per acre. In irrigating alfalfa on sandy soils, 5 hours of hand labor were used annually; on heavy soils only 2.8 hours were needed. Baling and hauling were also done with hand labor. Sugar beets required large amounts of hand labor. Spreading water required 6 hours per acre. Seasonal workers were hired for 263 hours of thinning and hoeing per acre. Ditching and irrigating potatoes took 3.4 hours of seasonal hand labor, and to pick up, sack, and load an acre of potatoes took about 46 hours.

Mazurak, A. P., Cosper, H. R., and Rhoades, H. F. RATE OF WATER ENTRY INTO AN IRRIGATED CHESTNUT SOIL AS AFFECTED BY 39 YEARS OF CROPPING AND MANURIAL PRACTICES. Agron. Jour. 47: 490-493. 1955.

A constant rate of water entry into Tripp soil was usually obtained after 2 hours of irrigation. The intake of water was influenced by applying the results from manure and cropping history during 39 years. Maximum rates of water entry after 2 hours of irrigation were obtained in the continuous alfalfa plots; the rates were 30.6 and 37.0 c.m. per hour for the nonmanured and manured treatments, respectively. A minimum rate, 0.5 c.m. per hour, of water entry into soil after 2 hours of irrigation was obtained for continuous corn. Where manure was applied annually since 1942 to the continuous corn plot, the rate of water entry was 6.8 c.m. per hour.

Pruitt, W. O. IRRIGATION SCHEDULING GUIDE. Agr. Engin. 37: 180-181. 1956.

An irrigation guide is described which it is believed can be used to advantage where estimated consumptive-use data are available. It is simple to operate by the farmer once it is set up for him. The farmer at a glance could estimate the moisture reserves in the soil.

Reeve, R. C., Pillsbury, A. F., and Wilcox, L. V. RECLAMATION OF A SALINE AND BORON SOIL IN THE COACHELLA VALLEY OF CALIFORNIA. Hilgardia. 24: 69-91. 1955.

Reported herein are results of both flushing and leaching salts from a saline-alkali soil in the Coachella Valley of California's Colorado Desert. The paper presents a quantitative evalu-

ation of the effectiveness of removing a salt crust by flushing, and it compares the removal of the usual salts with the removal of a high concentration of B. Flushing as a reclamation procedure was ineffective. Leaching removed 80 percent of the initially high salts with the application of 1 foot of water for each foot depth of soil considered. Equal leaching of B required three times as much water.

Robinson, A. R., and Rohwer, C. MEASUREMENT OF CANAL SEEPAGE. Amer. Soc. Civ. Engin. Proc. Vol. 81, Sep. No. 728. June 1955.

The purpose of this study was to (1) review the existing methods of measuring seepage, (2) develop new methods of measuring seepage, and (3) examine the factors that affect seepage.

Seepage rings were used in the study because they were accurate in measuring seepage rates in small, isolated areas. The study showed that soil type was only one factor determining the seepage rate.

Calibration of seepage meters showed that although the meters do not provide an accurate method of measuring seepage, they do indicate the order of the loss.

Scott, V. H. PREFABRICATED LININGS FOR IRRIGATION DITCHES. Agr. Engin. 37: 113-116, 119. 1956.

Prefabricated linings in small irrigation farm ditches and reservoirs are needed if good water management is to be accomplished. A prefabricated lining should be relatively light in weight, be chemically inert, be flexible, be tough, be resistant to impact, be durable, be resistant to vegetative growth, be low in transmitting water, be resistant to bacterial attack, be easily and inexpensively maintained, and be low in initial cost.

Thorfinnson, T. S., Hunt, M., and Epp, A. W. COST OF DISTRIBUTION OF IRRIGATION WATER BY DIFFERENT METHODS. Nebr. Agr. Expt. Sta. Bul. 432. 1955.

The average investment in irrigation equipment per acre irrigated was found to be $11.00 for the siphon-tube method, $46.00 for gated pipe, and $67.00 for sprinklers. The number of man-hours of labor required for one irrigation per acre of corn was 0.90 for siphon tubes, 0.71 for gated pipe, and 1.41 for sprinklers. Considering only labor, repairs for equipment, and power needs, operation costs were least with siphon tubes and most with sprinklers. When depreciation, interest, and taxes on equipment are included, the total costs were $1.29 per acre for one irrigation with siphon tubes, $2.56 with gated pipe, and $7.70 with sprinklers. The largest item of operating cost for sprinklers was that of putting pressure in the sprinkler line. For both sprinklers and gated pipes the depreciation, interest, and taxes on equipment were much higher than for the siphon tube method.

Van Der Molen, W. H. DESALINIZATION OF SALINE SOILS AS A COLUMN PROCESS. Soil Sci. 81: 19-27. 1956.

The desalinization of soil profiles observed after the inundations of 1944-45 in the Southwestern part of the Netherlands was compared with the Glueckauf theory of column operation. In this comparison a good qualitative agreement between observations and theory was found, even for non-homogeneously saline profiles. Quantitatively, for light soils, the values of v predicted from the theory do not deviate more than 20 percent from the observed values. In heavy soils, however, larger deviations occur as a result of the presence of cracks. The theoretical plate thickness-2 $\underline{k}$- in the profiles observed appeared to be approximately 5 c.m.

The theory of column operation may also be applied to movement of other soil constituents which are not adsorbed by the soil particles, for example, the leaching of NO_3 ions. In this respect the theory may serve as a tool in fertilizer placement research.

Wadleigh, C. H., Wilcox, L. V., and Gallatin, M. H. QUALITY OF IRRIGATION WATER. Jour. Soil and Water Cons. 11: 31-33. 1956.

This paper evaluates water quality as affected by naturally occurring solutes. No single threshold value may be designated below which salinity is of no concern and above which it would be hazardous. It is necessary to take into account factors, such as soil texture, initial level of soluble salts in the soil, number of irrigation applications to be made between effective leachings by rain, and crop being grown.

Erosion Control

Chepil, W. S. FACTORS THAT INFLUENCE CLOD STRUCTURE, AND ERODIBILITY OF SOIL BY WIND: IV. SAND, SILT, AND CLAY. Soil Sci. 80: 155-162. 1955.

The data indicate that sand particles have little or no cohesive property, are readily loosened by force of impact of wind-blown materials, and, except the coarse particles, are easily carried by the wind. Silt and clay, on the other hand, exhibit a cohesive property and, therefore, seldom exist as individual particles, but act as a binding agent in the formation of wind-resistant clods. It is difficult to say which of the two is a more effective binding agent for sand, for their effectiveness depends somewhat on their proportion to each other, and to the sand fraction. The first 5 percent of silt and clay mixed with sand was about equally effective in creating cloddiness, but the quality of clods was different in the two cases. Those formed with clay and sand were

harder and less subject to abrasion by wind-blown sand than were those formed from silt and sand. For proportions greater than about 5 percent and up to 100 percent the silt fraction created more clods, though the clods tended to be somewhat softer than those formed from clay and sand.

Hays, O. E. FACTORS INFLUENCING RUNOFF. Agr. Engin. 36: 732-735. 1955.

Protecting timber from fire and grazing produces a soil condition that will prevent runoff. The highest amounts of runoff were measured from spring grain following corn. During intense storms, runoff from cornland was less than that from 1st-year hay. The older the hay, the more winter runoff and the less growing season runoff. Second and third-year hay land yield one-fourth as much runoff as cornland and one-twelfth as much runoff as spring-grain land during intense, growing-season rains. Stripcropping and terracing are essential for controlling runoff and reducing soil losses on sloping silt loam soils in this area.

Smith, D. D. STORAGE POND DESIGN. Agr. Engin. 36: 743-746. 1955.

The three factors to be evaluated in design of farm reservoirs for an irrigation water supply are (1) irrigation requirement per year, (2) evaporation and seepage losses from the reservoir, and (3) drainage-area size and watershed yield. Evaporation losses from a 16-acre reservoir has averaged 73 percent of that from a standard United States Weather Bureau pan during the last 4 years, and 78 percent from a 1-acre pond. Seepage from a clay-blanketed reservoir 16 acres in size has averaged 1 inch per month, and 2-1/4 inches per month from the 1-acre pond without the blanket. Evaporation and seepage losses for the 16-acre reservoir, minus rainfall during the drought of 1953-54, totaled 24 inches per year of which one-half was seepage. The amount of runoff to be expected from a slowly permeable claypan-soil watershed 24 out of 25 years is 1 inch or more but for 2 consecutive years the amount is 4.3 inches or more. The amount of runoff from a watershed with moderately permeable soil was less than half that from a watershed with the slowly permeable soil.

Staple, W. J., and Lehane, J. J. THE INFLUENCE OF FIELD SHELTERBELTS ON WIND VELOCITY, EVAPORATION, SOIL MOISTURE AND CROP YIELD. Canad. Jour. Agr. Sci. 35: 441-453. 1955.

Five years' measurements of the influence of field shelterbelts on wind velocity, evaporation, soil moisture and crop yield are described. It is shown that shelterbelts and hedge rows reduce the velocity of cross-winds to a distance at least 20 times the height of the trees. In this way hedgerows, once established, reduce the hazard of soil drifting. The reduction in evaporation observed near field shelterbelts was small, and from the information available it does not appear likely that it would have a measurable influence on soil-moisture conservation or wheat yield.

Snow accumulation near shelterbelts varied from almost nil in years of low snowfall to drifts 70 feet wide in years of ample snowfall and strong winds. These snowdrifts increased the soil moisture near the shelters at seeding time, and thus in turn resulted in greater yields than those obtained in the center of the fields. The net increase in yield in one group of sheltered fields for the 5 years, taking into account the area occupied by the trees, was 0.7 bushel per acre. Increased yields due to snow accumulation in shelterbelt projects may occur to the extent that loss of snow to ditches or gullies is prevented or the distribution of the snow is improved.

Sutherland, W. N., and Shrader, W. D. DEGREES OF ADOPTION OF EROSION CONTROL PRACTICES IN SHELBY COUNTY, IOWA. Soil Sci. Soc. Proc. 20: 117-119. 1956.

A land use study in Shelby County, Iowa, is used as an example of a procedure for studying the land use status of an area. A land use history was obtained for 1950, 1951, 1952, and 1953 on a 2-percent statistical sample of the land in the county. Detailed soil survey information was available for the sample. The land use history was tabulated by soil units.

All land was classified as to the intensity of cropping and as to the intensity of treatment. When so classified, land use data can be readily compared against any appropriate standard. Comparisons of the land use history of two soil units against two different standards, a soil loss standard, and a crop yield standard are given. The degree of compliance on all soil units with the soil loss standard is presented.

There was no significant difference in the way in which any of the upland soils were being used but there is a wide difference in the degree of compliance with the soil loss standard.

United States Department of Agriculture. PROGRAM FOR THE GREAT PLAINS. U. S. Dept. Agr. Misc. Pub. 709. 1956.

The objective of the program for the Great Plains is to assist farmers and ranches to develop for themselves a land use program that will help them avert many of the hazards that arise from the recurring droughts common to the region.

The program focuses directly on the people of the Great Plains, the weather pattern, and the region's natural resources. It looks forward to preserving and enhancing a great productive capacity. It rests on the foundation blocks of further conservation, wise use, and management of the area's soil and water resources. It recognizes that if the agriculture of the region is to be stable certain parts ought to be permanently in grasses.

Tillage and Cultural Practices

Beale, O. W., Nutt, G. B., and Peele, T. C. THE EFFECTS OF MULCH TILLAGE ON RUNOFF, EROSION, SOIL PROPERTIES, AND CROP YIELDS. Soil Sci. Soc. Amer. Proc. 19: 244-247. 1955.

The effects of mulch and clean tillage methods on runoff, erosion, soil properties, and crop yields were studied for 10 years. Corn was grown each summer following winter cover crops of vetch and rye mixed and crimson clover. Mulch tilled land was prepared for planting corn by disk-harrowing and by disk-harrowing plus loosening the soil with a spring-tooth tiller. A disk or moldboard blow was used to prepare the turnplowed treatments.

Runoff and erosion were reduced considerably under mulch tillage. The degree of aggregation of the mulch tilled soil increased more rapidly than that of the turnplowed soil. The vetch and rye cover crop caused greater improvement in degree of aggregation than the crimson clover. Soil aggregation of the clean-tilled crimson clover treatment decreased during the test. Soil aggregation of the clean-tilled soil without a cover crop decreased significantly.

Engelbert, L. E., and Truog, E. CROP RESPONSE TO DEEP TILLAGE WITH LIME AND FERTILIZER. Soil Sci. Amer. Proc. 20: 50-54. 1956.

Investigations for 5 years on deep plowing, subsoiling, and deep incorporation of lime and fertilizer were conducted on Almena silt loam (strongly acid and tight subsoil). Subsoil treatments included tillage only, tillage with liming, and tillage with liming and fertilizing. The plow-layer of all subsoiled plots was limed to pH 6.5 and fertilized uniformly. Plots not subsoiled received varying amounts of fertilizer, equal in several cases to the total applied to both the plow-layer and subsoil of the subsoiled plots.

Deeper root penetration of alfalfa was promoted by subsoil liming and fertilizing, but not by subsoiling alone. Subsoil liming and fertilizing helped materially in establishing alfalfa during a dry year. Second-year and especially third--and fourth-year hay yields appeared to be increased (up to one-half ton per acre in dry years) by subsoil liming and fertilizing but were not increased by subsoil treatment where the fertilizer was omitted. The K content of the alfalfa from subsoil fertilized plots was as much as 1-percent higher during dry years.

Corn and oats did not appear to respond to these subsoil treatments even in the dry years, and when they followed the alfalfa-brome grown with subsoil treatments.

Locke, L. F., and Mathews, O. R. CULTURAL PRACTICES FOR SORGHUMS AND MISCELLANEOUS FIELD CROPS AT THE SOUTHERN GREAT PLAINS FIELD STATION, WOODWARD, OKLA. U. S. Dept. Agr. and Okla. Agr. Expt. Sta. Cir. 959. 1955.

This circular reports the results of tillage and rotation experiments with sorghums and several other crops at the Southern Great Plains Field Station, Woodward, Okla., 1915-48. Next to wheat, grain and forage sorghums are the most important crops in the area represented by the station.

Tillage experiments with sorghums showed that results from fall plowing were slightly superior to those from spring plowing but not enough higher to compensate for the greater soil-blowing hazard created. Plowing proved slightly superior to listing.

Results from tillage beginning in early spring were greatly superior to those from tillage beginning at or near the planting date.

Contour plantings of sorghums were more productive than noncontour operations, but the number of comparisons was not sufficient to establish specific differences.

Summer fallow was ineffective as a means of materially increasing acre yields of crops discussed in this circular, or reducing the number of low yields.

Equipment

Nichols, M. L., Cooper, A. W., and Reaves, C. A. DESIGN AND USE OF MACHINERY TO LOOSEN COMPACT SOIL. Soil Sci. Soc. Amer. Proc. 19: 128-130. 1955.

Excessive demand for information on methods and equipment for subsoiling and loosening compacted layers of soil has been a major factor in the development of a cooperative program of research between soil scientists and agricultural engineers in the United States Department of Agriculture and the State experiment stations. The engineering part of the program is directed towards mechanically producing soil conditions found desirable by the soil and plant scientists. It is based upon soil and machine relationships and has the objectives of (1) preventing the formation of compact layers by machine traffic and (2) the development of equipment and methods of use for loosening compacted layers when formed. The engineering program consists of (a) field studies and experiments with various commercial subsoilers and sweeps, (b) laboratory studies of the relationships of elements of design to the reactions of a range of soils in various conditions whose physical properties are measured, and (c) the production and testing of experimental designs based upon information gained from the field and design studies. The soil physical properties found

to relate directly to design are resistance to compression, shear value, modulus of rupture, and arch action (defined as the vectoring out through a mass of soil of pressures applied to the surface). Design elements are evaluated first by determining the reaction of moist sand where light stresses result in visible strains permitting a qualitative appraisal of the pressures generated by the implement. Quantitative evaluation of the design elements is obtained by testing against heavier soils having known physical properties.

CROPS

General

Arnold, L. E. THE EFFECT OF SOIL CONSERVATION DISTRICT PLANNING ON THE CROP ACREAGES IN THE UPPER THORNAPPLE RIVER WATERSHED. Michigan Agr. Expt. Sta. Quarterly Bull. 38: 317-328. 1955.

If soil and water conservation plans prepared for individual farms were followed, some significant changes in crop acreages would be made in the agriculture of the Upper Thornapple River watershed. The pilot study indicates the following changes have been recommended in the watershed, as a result of Soil Conservation Service planning:

Row crops and small grains would be decreased by 53,185 acres as a result of crop rotation. Rotation pasture would be increased by 134,928 acres as a result of rotation of pastures and pasture renovation. In areas having steeper slopes and sandy soils more susceptible to wind and water erosion, pasture and woodland would be increased by 2,820 acres. Some woodland clearing will be done on the more level and fertile areas. Idle or unclassified land has been designated for definite uses.

Bloodworth, M. E., Page, J. B., and Cowley, W. R. A THERMOELECTRIC METHOD FOR DETERMINING THE RATE OF WATER MOVEMENT IN PLANTS. Soil Sci. Soc. Amer. Proc. 19: 411-414. 1955.

A thermoelectric method is described for the measurement of streamflow rates in the stems of plants. It has a definite advantage in that repeated measurements can be made on the same plant without damage to it. The method is quite simple and usually requires about 15 minutes for each measurement.

By subjecting cotton plants to different environmental conditions such as temperature, humidity, and wind velocity, the rate of water uptake and movement in the stem dropped from 114 cm./hr. to 76 cm./hr. when the wind velocity was changed from high to low. A temperature of about 99°F. and 20-percent relative humidity was maintained in both cases. With no wind movement but having a temperature of 82°F. and 62-percent relative humidity, the rate of water movement for the same plant was 38 cm./hr.

Present data show that this method is well adapted for indicating the effects of microclimate, soil-moisture availability, and soil aeration upon the rate of water uptake and movement within intact plants. In addition, it has other uses which will be of interest to both the soil scientist and plant physiologist.

Field Crops

Blake, G. R., and Aldrich, R. J. EFFECTS OF CULTIVATION ON SOME SOIL PHYSICAL PROPERTIES AND ON POTATO AND CORN YIELDS. Soil Sci. Soc. Amer. Proc. 19: 400-403. 1955.

Field corn and potatoes were cultivated 0 to 3 times and 0 to 5 or 7, respectively for 3 years, to determine the best level of cultivation for each crop. Weeds were controlled with chemicals so that the noncultivated plots were neither hoed nor scraped. One cultivation for corn or one or two for potatoes gave virtually as high yields as any greater number. All amounts of cultivation gave higher yields than none at all.

Excessive cultivation resulted in lower air space and aggregation and higher bulk density though these differences were not always significant. Cultivation and sprayer traffic was shown to result in a generally lower K content of potato leaves.

Burleson, C. A., Cowley, W. R., Hubbard, J. L., and Otey, G. GRAIN SORGHUM FERTILIZER TRIAL, LOWER RIO GRANDE VALLEY, 1955. Tex. Agr. Expt. Sta. Prog. Rpt. 1823. November 3, 1955.

A grain sorghum fertilizer experiment was conducted cooperatively by the Lower Rio Grande Valley Experiment Station at Weslaco and Rio Farms, Inc., of Monte Alto.

Application of 60 and 120 pounds of N hastened maturity and significantly increased the yields of grain and forage of Redbine 66 grain sorghum grown under irrigation on a Brennan fine sandy loam.

Phosphoric acid and potash alone or in any combination did not affect yields or maturity.

Center, C. F., Eheart, J. F., and Linkous, W. N. EFFECTS OF LOCATION, HYBRID, FERTILIZER, AND RATE OF PLANTING ON THE OIL AND PROTEIN CONTENTS OF CORN GRAIN. Agron. Jour. 48: 63-67. February 1956.

With 7 corn hybrids at various locations in Virginia, hybrids were more important than growing conditions as a source of variation in oil content. The reverse was true for the effect on protein content. With 3 levels of H, P, and K, and at 10,000 and 16,000 plants per acre, the lo-

cation, planting rate, and N level all significantly affected protein content. Protein content was significantly higher under drought conditions than under good growing conditions. Highest protein yields occurred with the higher plant stand and heaviest N application. None of the factors had any appreciable effect on oil content.

Cheaney, R. L. EFFECT OF TIME OF DRAINING OF RICE ON THE PREVENTION OF STRAIGHTHEAD. Tex. Agr. Expt. Sta. Prog. Rpt. 1774. 1955.

Century Patna 231 is very susceptible to straighthead on sandy soil but this condition can be controlled in such susceptible varieties by draining the irrigation water from the field just prior to the jointing or stem elongation stage (about 50 days after emergence). Where the supply of irrigation water may be short, a resistant variety should be planted.

Daniel, H. A. CROP STUBBLE MANAGEMENT BY FLEXIBLE TILLAGE IN CONSERVATION FARMING. 10th Annual Crops, Soils, and Fertilizer Conference Proc., Stillwater, Okla. February 10-11, 1955.

Contour farming alone was not enough, however, for controlling erosion on the steeper slopes. Where a combination of terraces and contour cultivation was used, the average amount of runoff from the 4 types of plowing was reduced 35.4 percent. The actual percent of precipitation lost in runoff from the land cultivated with the slope was 14.99, while that from the terraced and contour cultivated areas was only 9.69. Terraces placed at different vertical intervals were investigated. The greatest saving of runoff water was where contour cultivation and terraces with spacings of 3 feet were used on a land slope of 1.7 to 3.0 percent. However, terraces with vertical intervals as great as 8 feet, when supplemented with contour cultivation, reduced runoff waterlosses.

Fehrenbacher, J. B., and Alexander, J. D. A METHOD FOR STUDYING CORN ROOT DISTRIBUTION USING A SOIL-CORE SAMPLING MACHINE AND SHAKER-TYPE WASHER. Agron. Jour. 47: 468-472. 1955.

A method of sampling roots in concentric rings around a corn hill with the Kelley soil-core sampling machine was devised. With this machine, satisfactory 4-inch diameter cores were taken to a depth of 6 feet in Flanagan silt loam.

A shaker-type washer was used to remove most of the soil from the roots. Final separation of the roots from the water-stable aggregates and from organic debris of previous crops was made with a small hand screen and tweezers.

Root weights per acre determined in this way appear to be in line with those obtained by the method of taking large soil-root monolith samples. The core-sampling method eliminates the need for large pits and gives more complete sampling at various distances from the corn hill in less time.

A significant difference in amount of roots was found on a treated and an untreated plot on Flanagan silt loam. From the limited data, it was found that in uniform soil the roots were symmetrically developed around the corn hill and that there was less difference between duplicate sets of cores from one hill than that between duplicate hills.

Fox, R. L., and Lipps, R. C. SUBIRRIGATION AND PLANT NUTRITION. I. ALFALFA ROOT DISTRIBUTION AND SOIL PROPERTIES. Soil Sci. Soc. Amer. Proc. 19: 468-473. 1955.

Root systems of subirrigated alfalfa plants and some associated soil properties were studied. Under certain conditions a concentration of fibrous roots occurred in saturated soil above and below the water table. Roots occurred in abundance in pockets of fine sand and silt while adjacent pockets of moist sand and gravel were essentially devoid of roots. These observations and soil analyses suggest that root distribution is, in part, governed by nutrient availability.

Nodules occurred in abundance in the A horizon of a buried soil while the surface soil, which was more acid, contained roots without nodules and with only limited branching. Alfalfa roots penetrated soil horizons which contained much Na. They branched extensively in a region of high Na where Ca and Mg were present in abundance.

Root distribution of subirrigated alfalfa suggests two important regions of water and nutrient sorption. These are the moisture fringe above the water table and the surface soil. Both should be considered when interpreting soil tests, evaluating results of fertilizer experiments, and explaining plant growth variations.

Harward, M. E., Jackson, W. A., Nielson, L. W., Piland, J. R., and Mason, D. D. EFFECTS OF SOIL MOISTURE TENSIONS AND OF CHLORIDE AND SULFATE TREATMENTS UPON THE YIELD, COMPOSITION, AND BACTERIAL SOFT ROT OF IRISH POTATOES. Soil Sci. Soc. Amer. Proc. 20: 59-65. 1956.

Greenhouse experiments were conducted for 2 years to determine the effects of soil moisture and of the chloride and sulfate ions upon the growth and quality of potato tubers.

Irish cobbler potatoes were grown in a soil mixture containing equal weights of Bladen fine sandy loam and 18-mesh quartz sand. The anion variables consisted of KCl or K_2SO_4 applied at the rate of 180 pounds K_2O per acre. The different moisture levels consisted of resaturating the soil when tensions of about 300, 800, 2,000, and 10,000 cm. of water were obtained. Measurements of yield, chemical composition, dry mat-

ter, specific gravity of tubers, and susceptibility of tubers to bacterial soft rot were made at or after harvest.

The yields of U. S. No. 1 tubers from the SO_4-treated plots were greater than those receiving Cl. There were some suggestions that the response to high levels of soil moisture may have been related to the source of K. Greater vine yields were obtained with the chloride treatments than with the sulfate. A reversal in the curve for growth of tops occurred at the lowest level of soil moisture. The use of chloride as compared to sulfate increased the content of Ca and Mg in the leaves and stems and decreased the content of Mg in the tubers. The K contents of tubers were greater with the SO_4 than with the Cl treatments but no differences in K content of leaves were associated with source of K. Applications of SO_4 as compared to Cl at all moisture levels resulted in increased contents of N in the leaves, stems, and tubers.

Hodgson, H. J. EFFECT OF SEEDING RATE AND TIME OF HARVEST ON YIELD AND QUALITY OF OAT-PEA FORAGE. Agron. Jour. 48: 87-90. 1956.

Mixtures of 50 to 65 pounds of peas and 35 to 50 pounds of oats per acre produced both highest yields and highest percent dry matter and protein in Alaska experiments. Late milk to early dough stage appeared best for harvest. At later stages, higher dry-matter content offset protein gains in silage use.

Robins, J. S., and Domingo, C. E. MOISTURE DEFICITS IN RELATION TO THE GROWTH AND DEVELOPMENT OF DRY BEANS. Agron. Jour. 48: 67-70. 1956.

Yield reductions of about 20 percent under visible moisture stress were measured in Washington State. Causes were as follows: reduction in number of pods before blooming; reduction in number of pods and number of beans per pod during blooming; and reduction in bean weight during maturing process. Plant development was retarded by stress before blooming and hastened during blooming and maturity. Irrigation before visible moisture stress appeared to offer no advantage.

Russel, D. A., Kurtz, L. T., and Melsted, S. W. THE RESPONSE OF ALFALFA TO BORAX FERTILIZER ON ILLINOIS SOILS. Soil Sci. Soc. Amer. Proc. 19: 474-477. 1955.

A 2-year study was made of the response of alfalfa to varying rates of borax fertilizer applied to Illinois soils. Fourteen locations suffering in water-soluble B content, in soil type, and in the type of legume grown were selected; the trials at 5 of these locations were continued the second year. Borax fertilizer was applied in the spring of the first year (1952) on established legume stands at the rate of 0, 30, 60, and 90 pounds per acre. A randomized blocks design of 9 replications was used in measuring the effect of the borax treatment upon seed yield, hay yield, and leaf-to-stem weight ratios. A modified Berger-Truog quinalizarin procedure was used in measuring the water-soluble B content of the soils. Details of the modification are given.

The general conclusion was that many of the soils in Illinois are at a stage of B indigence at which B-deficiency symptoms are produced readily, especially under climatic extremes. In only a relatively few cases are the soils low enough in available B to reduce the yield of alfalfa hay.

Selman, F. L., and Rouse, R. EARLY FRUITING AND FALL MATURITY OF COTTON AS AFFECTED BY SODIUM AND ROOT AERATION. Soil Sci. 80: 281-286. 1955.

A study was conducted to obtain information concerning the effect of Na and root aeration on the cotton plant. This report includes the results of two sand-culture experiments conducted consecutively.

The addition of Na to nutrient solution increased early fruiting and fall maturity of cotton when grown under conditions of poor root aeration, but not under conditions of good aeration. Poor aeration alone increased these factors at adequate and high K levels. Early fruiting did not affect final yield, and only when K was deficient was a yield response to Na indicated.

Shear, G. M., and Miller, L. I. FACTORS AFFECTING FRUIT DEVELOPMENT OF THE JUMBO RUNNER PEANUT. Agron. Jour. 47: 354-357. 1955.

The development of fruit of a selection of the Holland strain of the Jumbo Runner peanut was studied by means of peg removal or peg tagging. The removal of pegs from the beginning of peg formation until the latter part of August did not reduce the number of large fruit at harvest, although later formed fruit were less mature at harvest. Thus, the number of fruit that peanut plants of a given size will produce appears to be quite definite.

Pegs produced from late August until flowering ceased, on plants which had not been previously disturbed, did not have a significant effect on yield.

Sutherland, J. G., and James, H. B. COTTON MECHANIZATION IN NORTH CAROLINA. N. C. Agr. Expt. Sta. Tech. Bul. 104. 1954.

This is a report of a survey of 1947 cotton-production practices in both the Southern Piedmont and the cotton-tobacco area of the Coastal Plain of North Carolina. The survey was made in 1948. The competitive position of cotton in North Carolina agriculture has declined in recent years. The large amount of labor required

and the increasing cost of labor and other inputs have resulted in higher rather than lower costs of production. The degree of mechanization attained on most farms does not permit large reductions in costs. In 1947, with nonmechanized methods of production about 138 man-hours of labor per acre were used. Production with tractor power, and hand weeding, chopping, and harvesting required about 118 man-hours. With complete mechanization - rotary weeders and mechanical pickers - 24 man-hours sufficed. With rotary weeders and mechanical strippers, only 22 man-hours per acre were needed. The cost of mechanical harvesting varied inversely with yields and with the number of bales harvested per machine. The larger the number of acres harvested and the higher the yields, the lower was the cost per bale of mechanical harvesting. In cotton yielding 337 pounds of lint per acre, hand picking at $4.00 per 100 pounds of seed cotton was more economical than mechanical picking on less than 120 acres but less economical than mechanical stripping when more than 36 acres were harvested per machine per season. In cotton yielding a bale of lint per acre, hand picking at the rate of $4.00 was less economical than mechanical stripping when more than 25 acres were stripped, and it was less economical than mechanical picking when more than 75 acres were mechanically picked per machine per season. Relatively few North Carolina farms can raise enough cotton to justify the purchase of a mechanical picker. Custom harvesting is advised.

Wallace, A. T., and Chapman, W. H. STUDIES IN PLOT TECHNIQUE FOR OAT CLIPPING EXPERIMENTS. Agron. Jour. 48: 32-35. 1956.

Two years' uniformity data from clipped oats were used to estimate soil heterogeneity indexes. The long narrow plot had the smaller heterogeneity index.

These indexes, along with cost functions, were used to estimate plot size. The optimum plot size was 1 row of oats 8 feet long. Coefficients of variation were estimated, and conclusions from these estimates indicated that 4 or 5 replications are required to give a suitable degree of accuracy in clipping oats. Analyses of variance on data from an experiment planted to 3 varieties of oats in plots 9 and 18 inches apart at 2- and 4-bushel seeding rates indicate that the relative performances of these varieties were the same at both spacings and at both seeding rates.

Wiggans, S. C. THE EFFECT OF SEASONAL TEMPERATURES ON MATURITY OF OATS PLANTED AT DIFFERENT DATES. Agron. Jour. 48: 21-25. 1956.

The accumulation of temperature over 40° F. required to mature a given variety of oats was about the same for seedings made in April or early May. Early-maturing varieties required fewer heat units to reach maturity than late-maturing varieties. Very late planted oats, which are exposed to infection from rusts and other diseases causing premature ripening, required somewhat fewer heat units. There was a definite decrease in yield from oats seeded after the middle of April.

Data from several years indicate there is little variation from year to year in the number of heat units required for a specific variety to reach maturity. Some variation may be caused by incidence of disease, rainfall, soil type, fertility level, depth of planting, and plant population. However, temperature seems to be the primary factor affecting maturity.

Oats planted for 8 weeks in the early spring, when temperatures are relatively cool, will generally ripen during a 2-week period in July at Ames, Iowa. Thus, a 3- to 4-day delay in seeding represents about a 1-day delay in maturity.

Pasture and Range

Arnold, J. F. PLANT LIFE-FORM CLASSIFICATION AND ITS USE IN EVALUATING RANGE CONDITIONS AND TREND. Jour. Range Mgt. 8: 176-181. 1955.

Plantlife form provides a convenient basis for visually evaluating ecological dominance and subordination in natural communities, the susceptibilities of different plants to grazing injury and to injury from other land use disturbances, and stages of secondary succession and recovery that result when disturbances are reduced or removed.

Plantlife form provides a visual means of evaluating ecological range condition because the life forms that prevail on a given range unit indicate conditions with respect to herbage yields, organic mulch, range vigor, and soil erosion.

Trends in leaf development and in annual yields fluctuate erratically in the short run with seasonal and annual variations in climate. Trends in plantlife forms and range productivity change slowly in the long run in response to changes in management practices.

The recognition of plantlife forms helps to evaluate range productivity, to establish the goals for proper stocking, to distinguish differences in grazing preferences, to establish the needs for seasonal use and other systems of grazing, and to estimate the economic justification for restoring depleted ranges by artificial reseeding.

Barker, M. G., Hanley, F., and Ridgman, W. J. STUDIES ON LUCERNE AND LUCERNE-GRASS LEYS. Jour. Agri. Sci. 46 (3): 362-375.

Two experiments, designed to compare cutting and grazing the second (July) crop, and cut-

ing and grazing the third crop at two different dates (Sept. and Oct.) each year on the yield and botanical composition of a lucerne-grass (mainly cocksfoot) ley, are described and the results discussed.

The method of defoliating both the second and the third crops had very little lasting effect on yield or composition of the ley, though some temporary effects, depending on season, were found.

Bates, R. P. EFFECTS OF PHOTOPERIODS ON PLANT GROWTH, FLOWERING, SEED PRODUCTION, AND TANNIN CONTENT OF LESPEDEZA CUNEATA DON. Agr. Jour. 47: 564-567. 1955.

Very little vegetative growth was obtained from L. cuneata plants grown under daylengths of less than 13 hours.

The 13-hour day produced fair growth and resulted in the most flowering and best seed production. The 13-hour photoperiod was the only treatment which resulted in production of chasmogamous flowers by all strains. Neither cleistogamous nor chasmogamous flowers were produced under photoperiods of 14 hours or longer. Tannin content of sericea lespedeza leaves increased as daylength increased. Different strains of sericea behaved differently under different daylengths.

Blaser, R. E., Ritchey, G. E., Kirk, W. G., and Arnold, P. T. D. EXPERIMENTS WITH NAPIER GRASS. Univ. Fla. Expt. Sta. Bul. 568. 1955.

A total of 209,208 pounds of 4.0 percent fat-corrected milk was produced from the 8-acre area for the 5 years. This was in addition to the maintenance requirements of all cows. The 1943 season's herbage was utilized partly by milking cows and partly by dry cows. Grazing days for milking cows for the entire period amounted to 7,673 cow-days. Thus a production of 27.26 pounds of 4.0 fat-corrected milk was obtained daily per cow when fed concentrated at the rate of 1 pound of feed to approximately 3 pounds of milk produced.

Excluding the 1943 season, 188,478 pounds of 4.0 percent fat-corrected milk was produced for 4 seasons on the 8-acre area, making an annual production per acre of 5,889 pounds of 4.0 percent fat-corrected milk.

Throughout the 5 years it was computed by standard methods that the Napier grass on the 8-acre area provided 75,866 pounds of total digestible nutrients, or an average of 1,897 pounds per acre per season. This is equivalent to about 2 tons of green leafy grass hay per acre. The season averaged 171 calendar days and 1,686 cow-days grazing. Thus the total digestible nutrient yield averaged 88.5 pounds per calendar day and 9.0 pounds per cow-day.

Blaser, R. E., Taylor, T., Griffeth, W., and Skrdla, W. SEEDLING COMPETITION IN ESTABLISHING FORAGE PLANTS. Agron. Jour. 48: 1-6. 1956.

Data are reported on stand and growth of plants of perennial grasses and legumes as influenced by species, varieties, and dates of seeding.

Forages differ in rates of establishment; hence the species may be classified into groups of very aggressive, aggressive, and nonaggressive seedling development. Aggressiveness during establishment is associated with seedling emergence and survival and with growth rate of seedling plants. Growth rate and survival of seedlings vary with August and March seedlings. Species that are aggressive when seeded in the spring are not necessarily aggressive when seeded in the summer. The variation in survival and growth rate among forage seedlings under spring and summer seedings is attributed to differential responses among the species to the temperature and moisture conditions prevailing during the season when seeded.

The application of the data for compounding mixtures to aid in obtaining a desired botanical composition under various environmental conditions is discussed.

Buller, R. E., Bubar, J. S., Fortmann, H. R., and Carnahan, H. L. EFFECTS OF NITROGEN FERTILIZATION AND RATE AND METHOD OF SEEDING ON GRASS SEED YIELDS IN PENNSYLVANIA. Agr. Jour. 47: 559-563. 1955.

Seed yield responses to various cultural practices were studied for reed canarygrass, smooth bromegrass, orchardgrass, and timothy in 1952 and 1953 at the Pennsylvania Agricultural Experiment Station. Variables studied consisted of row and broadcast methods of seeding, 7 N treatments, and 2 rates of seeding. The experiment was conducted on a soil of medium fertility.

Seed production was best in the second harvest year with all grasses except smooth bromegrass.

All grasses produced a significantly higher seed yield in rows than in broadcast plots.

Dorschner, K. P., and Buchholtz, K. P. WETTING ABILITY OF AQUEOUS HERBICIDAL SPRAYS AS A FACTOR INFLUENCING STANDS OF ALFALFA SEEDLINGS. Agron. Jour. 48: 59-63. 1956.

Wetting ability of an herbicidal solution was a significant factor in determining the toxicity of preparations and rates of any one compound but was of minor importance in explaining differences in toxicity between chemicals. The preparation 2,4-D was the most toxic, followed by 2,4,5,-T, MCP, 3,4-D, and 2,5-D in that order. Artificial shading indicated that light

available to alfalfa seedings in oats was important in maintaining alfalfa stand. Shading increased the wettability of alfalfa leaves and presumably increased the toxicity of herbicides applied.

Fisher, F. L., Caldwell, A. G., and Fudge, J. F. NITROGEN REQUIREMENTS OF COASTAL BERMUDAGRASS UNDER SUPPLEMENTAL IRRIGATION AT COLLEGE STATION. Tex. Agr. Expt. Sta. Prog. Rpt. 1837. December 20, 1955.

Studies conducted near College Station in 1953-55 with Coastal bermudagrass show an average hay yield of over 13 tons per acre per year with a protein content of about 14 percent. These results required the application of 150 to 200 pounds of N per acre after each harvest and 1 to 2 inches of water a week from rainfall or irrigation.

Large initial applications of P, K, and lime also were required.

Fox, R. L., and Lipps, R. C. INFLUENCE OF SOIL-PROFILE CHARACTERISTICS UPON THE DISTRIBUTION OF ROOTS AND NODULES OF ALFALFA AND SWEETCLOVER. Agron. Jour. 47: 361-367. 1955.

A study was made of the influence of exchangeable Ca, available P, and soil texture in the profile of 4 Nebraska soils on root development and nodulation by alfalfa and sweetclover.

The development of alfalfa root systems growing on limed and unlimed acid soils was studied for 3 years. During the first season alfalfa roots penetrated more than 5 feet into the limed soil, while those of unlimed alfalfa reached a maximum depth of only 36 inches. Unlimed alfalfa was unproductive during the first year but became progressively higher during the second and third years. Root samples indicated that accelerated growth was accompanied by root penetration of soil material below 3 feet which was better supplied with nutrients. Root and nodule development reflected the availability of soil nutrients in the various horizons.

Frischknecht, N. C., and Plummer, A. P. A COMPARISON OF SEEDED GRASSES UNDER GRAZING AND PROTECTION ON A MOUNTAIN BRUSH BURN. Jour. Range Mgt. 8: 170-175. 1955.

Twenty-two grasses were seeded on contour strips with smooth brome on a mountain brush site in the fall of 1944. Two transects were established across all strips in 1946; one was fenced to exclude livestock grazing whereas the other was grazed heavily by livestock each year since establishment until 1952. Except for 2 years when cattle broke through the fence, livestock were excluded from the protected transects. Final inventories were made in 1953.

Prolonged heavy grazing was damaging to the seeded grasses in that total yield on the heavily grazed transect was only 56 percent of the yield under protection. However, results from small enclosures showed virtually complete recovery of high grass yields in the second year of protection. Thus, it would appear that where grazing must ordinarily be heavy on seeded ranges, giving complete rest occasionally would assist in maintaining grasses in a high state of productivity.

Holmes, W., and MacLusky, D. S. THE INTENSIVE PRODUCTION OF HERBAGE FOR CROP-DRYING. Jour. Agri. Sci. 46 (3): 267-286. 1955.

An experiment is described which lasted for 5 years and in which a comparison was made of 12 grasses or grass mixtures under different fertilizer N treatments and also when grown with clover. The herbage was cut 4-6 times in each season. Adequate amounts of mineral fertilizers (280-340 lb. K_2O and about 100 lb. P_2O_5 per acre per annum), and the following N treatments were applied: (1) No N, no clover, (2) grass sown with clover, (3) 140-208 lb. N per acre per annum in 4 to 6 equal dressings, (4) 350-416 lb. N per acre per annum in 5 and 6 equal dressings.

In 1951, 1952, and 1953 the clover dominant swards (treatment 2) were split between the following treatments; (X) as (3) above, (Y) 35 lb. N per acre in spring and again in late summer, (Z) no nitrogen as (2) above.

The average yields for the 4 years were 2,180, 5,940, and 8,300 lb. dry matter per acre, and 290, 850, and 1,460 lb. crude protein per acre for treatments 1, 3, and 4. With treatment 2 the average yields were 2,830 lb. dry matter and 400 lb. crude protein in 1949 and 4,270 lb. dry matter and 820 lb. crude protein in 1950. An approximate average yield for the 4 years from treatment 2 was 4,630 lb. dry matter and 860 lb. crude protein. In 1951-53 average yields for treatments 2X, 2Y, and 2Z were, 7,240, 6,340 and 5,750 lb. dry matter and 1,240, 1,180 and 1,100 lb. crude protein per acre.

Huss, D. L. A BASIS FOR A CONSERVATION LEASE OF RANGELAND ON THE EDWARDS PLATEAU OF TEXAS. Jour. Range Mgt. 8: 208-210. 1955.

Leased lands constitute one-third of the Edwards Plateau and leased lands are usually over utilized. The faults of existing lease agreements contribute to this situation. A better understanding of proper land use by the lessee and lessor is the only stable manner in which this situation can be corrected. Until that time, lease agreements which will lead to proper range use should be employed. A system is proposed which is based on carrying capacity as determined by range condition and site classification. Other

problems which should be considered in the formulation of a lease agreement are discussed.

Hyder, D. N., Sneva, F. A., and Sawyer, W. A. SOIL FIRMING MAY IMPROVE RANGE SEEDING OPERATIONS. Jour. Range Mgt. 8: 159-163. 1955.

Studies of seedbed treatments were made to find the value of soil firmness to seeding success on sandy loam soils supporting sagebrush-bunchgrass before clearing.

Rolling before drilling may improve seed placement and give good seedling emergence. However, the use of depth bands on drill disks is effective and more practical than rolling. To be economically feasible, rolling prior to drilling must provide additional benefits with reference to seed-soil and plant-soil relations.

Rolling after broadcasting to cover seed and firm the soil has been a reliable seeding operation on freshly plowed seedbeds. However, the operation is limited in efficiency as compaction in the soil above the seed reduces emergence and may restrict germination due to poor aeration. Loosening the surface soil by shallow harrowing after broadcasting and rolling proved beneficial to total emergence.

Jones, D. W., Hodges, E. M., and Kirk, W. G. YEAR-ROUND GRAZING ON A COMBINATION OF NATIVE AND IMPROVED PASTURE. Fla. Agr. Expt. Sta. Bul. 554. 1954.

Using native and improved pasture to supplement each other is a management system that can be employed successfully. The combination reduces the acreage required per cow as compared with native range and provides more feed of higher quality. Winter-feed supply, the most critical shortcoming of the native range, can be greatly increased by a deferred grazing schedule. This additional feat greatly reduces weight declines and death losses and increases the production of the herd.

Kneebone, W. R. BREEDING FOR SEEDLING VIGOR IN SAND BLUESTEM (ANDROPOGON HALLII HACK.) AND OTHER NATIVE GRASSES. Agron. Jour. 48: 37-40. 1956.

Ranges in average weight per 500 seeds within sand bluestem, Indian grass, switchgrass, buffalograss, and sideoats grama were determined from data obtained on individual plant selections and field collections made in the Great Plains area. Additional estimates were derived from published information. From various lines of evidence it appears evident that variations in seed size observed are at least partly heritable and that progress may be made in breeding for larger caryopses. Of the species studied, sand bluestem appeared the most promising for breeding both for larger seed size and greater seedling vigor. Large seeded sand bluestem selections tended to set seed better, have less seed damaged in processing, and have more vigorous progenies than did small seeded selections. One cycle of selection in side-oats grama for more vigorous seedlings gave increases in seedling vigor. Selected plants produced larger than average caryopses.

Knight, W. E. THE INFLUENCE OF PHOTOPERIOD AND TEMPERATURE ON GROWTH, FLOWERING, AND SEED PRODUCTION OF DALLISGRASS, PASPALUM DILATATUM POIR. Agr. Jour. 47: 555-559. 1955.

Two selections of Dallis grass from Louisiana were grown in the greenhouse in 1951-52 and 1952-53 to determine flowering and seed production response to photoperiod and temperature treatments.

Dallis grass was grown in one greenhouse under a night temperature of 65 to 70° F. and between 45 to 55° F. in another greenhouse. Day temperatures ranged from 70 to 80° F. in both houses.

The general response of Dallis grass to photoperiod and temperature was the same in 1951-52 and in 1952-53. Dallis grass filed to produce seed heads when grown under an 8-hour and a normal day. Seed-head production under a 12-hour day was erratic, and flowering was incomplete. A high night temperature and a 14-hour photoperiod appear to provide the most desirable environment for greenhouse production of Dallis grass. There appears to be no advantage from the standpoint of seed production in growing Dallis grass under low temperature during the formative period of growth. Low night temperatures inhibited seed-head formation in Dallis grass under long day.

Lynd, J. Q., Elder, W. C., and Totusek, R. PASTURE GRAZING TRIALS ON VARIOUS LAND TYPES. Okla. A. and M. Coll. Bul. B-445. 1955.

Results of grazing trials at the Southeast Oklahoma Pasture Fertility Station near Coalgate, Okla., for 1950-53 are reported. Pasture studies there dealt with beef production on bermudagrass-legume pastures, weeping lovegrass-legume pastures, and improved and unimproved native grass pastures.

An overgrazed 300-acre area of native grass was divided into two 150-acre pastures of similar soil types. One was given no treatment. The other was improved by various treatments. During the 4 years, 1949-52, the unimproved area produced an annual average of 14 calves from 16 cows with average weaning weights of 391 pounds. An improved pasture of equal area and similar land types produced an average of 21.8 calves from 26 cows weighing 421.5 pounds at weaning during that period.

Magee, A. C., Stone, B. H., and Rogers, R. H. DAIRY PASTURE IMPROVEMENT PRACTICES AND COSTS. Tex. Agr. Expt. Sta. Prog. Rpt. 1839. January 18, 1956.

Unimproved pastures in East Texas in 1954 furnished an average of only 50 days of grazing per acre, while 170 days of grazing per acre were provided by the 4 highest yielding permanent pastures included in a study of pasture-improvement practices on 36 dairy farms in 8 East Texas counties.

The highest yields were obtained from pastures on which there had been a 4-year improvement program. The total cost of improving these 4 pastures averaged $15.81 per acre annually.

Twenty-five dairymen invested $8.44 per acre annually from 1952 through 1954 and developed intermediate yielding permanent pastures. The average yield on these pastures in 1954 was 106 grazing days per acre.

The 7 lowest yielding improved pastures furnished only 70 days of grazing per acre. During the 4 years, an average of $4.09 per acre was spent annually for pasture improvement.

On the basis of results obtained in 1954, farmers with highest yielding improved pastures obtained 770 days of additional grazing for $100 invested in pasture improvement. Intermediate and lowest yielding improved pastures averaged 660 and 495 days of additional grazing, respectively, for each $100 spent for improvement.

Nelson, A. B., Gallup, W. D., Roos, O. B., and Darlow, A. E. SUPPLEMENTAL PHOSPHORUS REQUIREMENT OF RANGE BEEF CATTLE. Okla. Agr. Expt. Sta. Bul. T-54. 1955.

A mineral P supplement is beneficial for the production of beef cattle, both winter and summer, in southeastern Oklahoma. In normal years, P supplementation of beef cattle is not necessary in north central Oklahoma. However, in dry years a P supplement will provide a margin of safety.

Potts, R. C. SWEETCLOVER IN TEXAS. Tex. Agr. Expt. Sta. Bul. 791. 1955.

Four species of sweetclover, two biennials and two annuals, are now grown in Texas. The important varieties among these species are Madrid, Evergreen, Hubam, and annual yellow-flowered sweetclover.

Sweetclover is a good pasture crop and provides abundant grazing. Because of its characteristic bitter taste, the first reaction of cattle to sweetclover may be unfavorable, but they graze sweetclover readily when they become accustomed to it. On sweetclover-oat pasture at Temple, steers gained as much as 2.1 pounds per day. The quality of the forage, as measured by protein and phosphorus content, is excellent. Sweetclover grows well with perennial grasses, especially Johnson grass. When grown with oats, it is one of the best pasture combinations. Sweetclover makes good hay and silage. Spoiled sweetclover hay or silage contains dicoumarol which injures the fine capillaries and reduces the clotting power of the blood of animals.

Maximum soil benefits have been obtained from sweetclover by harvesting a seed crop and returning all the residue to the soil. On many farms, the production and sale of sweetclover seed are paying enterprises. Sweetclover planted in pur stands and managed for seed production gives highest seed yields. Experiments show that pollinating insects are necessary for good seed production. Cutting and windrowing the plants when two-thirds of the seeds have turned brown, allowing them to dry in windrow and then combining, is the most satisfactory method of harvesting the seed.

Riewe, M. F., and Smith, J. C. EFFECT OF FERTILIZER PLACEMENT ON PERENNIAL PASTURES. Tex. Agr. Expt. Sta. Bul. 805. 1955.

Three experiments were conducted on Dallis grass and white clover and one on little bluestem to determine the fertilizer and method of fertilizer placement required to maintain established perennial pastures and hay meadows on the Texas Coastal Prairie.

Any tillage, such as only a slight disturbance of the Dallis grass and white-clover sod as in banding fertilizer below the surface, or complete tillage as with a rotary tiller, favored the growth of ragweeds. Tillage favored the growth of white clover over the growth of Dallis grass. Application of phosphate increased the percentage of white clover in the mixture, irrespective of tillage treatment. Nitrogen in addition to phosphate increased the percentage of Dallis grass in the mixture and decreased the percentage of clover. Potash did not affect botanical composition.

Disking or rotary tilling the fertilizer into the soil or placing the fertilizer in a band below the surface did not increase forage production above that from the broadcast application in any experiment. In every case, both N and phosphate significantly increased forage yields.

Sperry, O. E., Dollahite, J. W., Morrow, J., and Hoffman, G. O. TEXAS RANGE PLANTS POISONOUS TO LIVESTOCK. Tex. Agr. Expt. Sta. Bul. 796. 1955.

Sixty-nine plants are listed in this bulletin. They are divided into 3 groups based on degree of toxicity. Group I contains 34 most hazardous plants on the range. Group II includes 22 plants that have low toxicity, are not abundant, or are not frequently grazed, and are less hazardous. Group III includes 13 plants recorded as toxic but usually not considered hazardous.

Each plant is described and illustrated by a photograph. Its geographical distribution is also shown on a map. Classes of livestock poisoned

by each plant are listed. The toxic principle is stated where known. Symptoms of the poison in different classes of livestock are described. Management and control measures of the plants are discussed.

Sprague, V. G. DISTRIBUTION OF ATMOSPHERIC MOISTURE IN THE MICROCLIMATE ABOVE A GRASS SOD. Agr. Jour. 47: 551-555. 1955.

Atmospheric moisture and temperature were determined from April through October 1952-54 at heights of 1-1/2, 3, 6, and 60 inches above a grass sod at State College, Pa. Measurements were taken at the even hours from 6 a. m. to 6 p. m. and at 3-hour intervals during the night.

The average moisture content of the air, for each month, decreased progressively with height. Near ground level, the moisture content of the air was greatest at noon or soon thereafter and was consistently greater during the day than during the night. At the standard 60-inch height the variation during the day was small. On cloudy days more water was in the air than on clear days.

Stitt, R. E., Hide, J. C., and Frahm, E. THE RESPONSE OF CRESTED WHEATGRASS AND VOLUNTEER SWEETCLOVER TO NITROGEN AND PHOSPHORUS UNDER DRYLAND CONDITIONS. Agr. Jour. 47: 568-572. 1955.

Two studies were made on the effects of different rates of application of ammonium nitrate and superphosphate alone and in combination to a mixed stand of crested wheatgrass and sweetclover that had been established 14 years.

In 1947, 25 pounds of N per acre increased the growth of crested wheatgrass during the application year, but similar applications in 1946 did not produce significant season-long yield increases, although it increased the early growth. The higher rates of application increased the yields in both 1946 and 1947.

Rates of application of 100 to 200 pounds per acre of N increased yields of crested wheatgrass in the second year following application.

Ammonium nitrate applications decreased the stand of second-year sweetclover the year following the application, apparently by discouraging the establishment of seedlings during the year of N application. The higher rates kept out sweetclover even in the third year following application.

Superphosphate increased the stands of sweetclover by helping survival during the seedling stage. The growth of grass was also increased when the superphosphate was used with a high rate of ammonium nitrate.

Stivers, R. K., Jackson, W. A., Ohlrogge, A. J., and Davis, R. L. THE RELATIONSHIPS OF VARIETIES AND FERTILIZATIONS TO OBSERVED SYMPTOMS OF ROOT ROTS AND WILT OF ALFALFA. Agron. Jour. 48: 71-73. 1956.

At three rates of H, P, and K in north central Indiana, the stand of third-year Buffalo alfalfa was poorer than Ranger and Grimm at the lowest rate, with less difference at the higher rates. More Buffalo plants had rot from the crown into the root, and at greater severity, than the other two. For all varieties, percentage of plants with rot into the roots was highest at the lowest fertilization rate; percentage infected plants with crown rot alone was highest at the highest fertilization rate. Stands and yields of Grimm were poorer than the other two in the fourth and fifth year at all rates. Bacterial wilt was more severe at the lowest rate of fertilization.

Sullivan. J. T., Phillips, T. G., Loughlin, M. E., and Sprague, V. G. CHEMICAL COMPOSITION OF SOME FORAGE GRASSES. II. SUCCESSIVE CUTTINGS DURING THE GROWING SEASON. Agron. Jour. 48: 11-14. 1956.

Eight grasses common to the Northeastern States were grown in small plots at State College, Pa., cut successively at intervals to simulate rotational grazing management, and analyzed for some of the major organic constituents. Data are reported on the crude protein, lignin, cellulose, crude fiber, ether extract, and soluble ash for 2 years and on moisture and yields for 1 year. Conclusions drawn from the data are:

Different species of grasses, when their average compositions were compared, differed significantly from one another in respect to many constituents. Reed canarygrass, orchardgrass, Kentucky bluegrass, tall oatgrass, and Alta fescue are all significantly higher in crude protein than redtop, bromegrass, and timothy. Species comparisons in respect to other constituents are reported.

Successive cuttings of grass through the season showed fluctuations in composition, many of statistical significance, but the changes were never of great magnitude.

Significant correlation coefficients among constituents are reported.

Thomas, G. W., and Young, V. A. RELATION OF SOILS, RAINFALL AND GRAZING MANAGEMENT TO VEGETATION--WESTERN EDWARDS PLATEAU OF TEXAS. Tex. Agr. Expt. Sta. Bul. 786. 1954.

Experiments were conducted from 1938-53 at the Range Station near Barnhart to study the effects of climate, soils, and grazing on the vegetation.

The 16 pastures have been subjected to different rates of stocking with various combinations of sheep and cattle since grazing experiments were started in 1938.

Vegetation on the experimental pastures is fairly representative of that supported by several million acres of rangeland on the Edwards Plateau. The most important forage species are tobosa, buffalo, and curly mesquitegrass. Associated with these grasses but in smaller amounts are three-awn grasses, side-oats gramma, vine mesquite, and many others. The poisonous bitterweed and annual broomweed are the most abundant weeds. Dominant woody species are mesquite, pricklypear, and cholla.

The nature of the soil has had a pronounced effect on the kind and amount of vegetation on the area. The soil has also influenced the response of the vegetation to grazing and rainfall.

A cover of tobosagrass is superior, from the standpoint of soil and water conservation, to a cover of buffalo or curly mesquite, or to bare ground, which is subject to annual weed growth during favorable rainfall. Tobosagrass favors more rapid rates of water intake into the soil, more stable soil aggregation, and a more favorable soil temperature for plant growth.

A close relationship was found between available forage and annual rainfall for 1938-53. However, fluctuations in the amount of forage usually lag from 1 to 3 years behind the fluctuations in annual rainfall. On areas heavily grazed by livestock, the vegetation does not respond immediately to wet or dry years. Certain changes in floristic composition are caused by the rainfall pattern and should be recognized and separated from changes due to grazing.

Trew, E. M., and Hoveland, C. S. IRRIGATED PASTURES FOR SOUTH TEXAS. Tex. Agr. Expt. Sta. Bul. 819. 1955.

It is possible to produce 1,000 pounds of beef gain or milk equivalent per acre on well-managed irrigated pastures in south Texas. Irrigated pastures offer good profits in milk or beef production and the best known method of soil improvement.

This bulletin reports the results of 6 years' research and demonstration work with grasses and legumes under irrigation in the Lower Rio Grande Valley and Winter Garden.

Adapted warm-season perennial grasses produced up to 15 tons of hay per acre per year. Coastal bermuda, buffel (T-4464), Rhodes, and blue panic appear to be the best perennial grasses for irrigated pastures in south Texas. Coastal bermuda and buffel (T-4464) are best suited for use on loamy to sandy soils. Blue panic produces less forage than the others, but withstands drought better. Guinea produces well with irrigation but requires careful grazing management. Angleton is used widely on heavy clay soils.

Some irrigated pasture management points discussed in this bulletin are proper fertilization, irrigation and grazing, utilization of excess grazing as hay or silage, clipping as needed, and scattering manure piles.

Willits, N. A., and Erickson, A. E. MOISTURE UTILIZATION BY SEVERAL FORAGE CROPS. Soil Sci. Soc. Proc. 20: 126-128. 1956.

During the growing seasons 1951-53, the moisture used by 2 grasses and 2 legumes was determined by use of Bouyoucos blocks. Stage of crop development had more effect than weather on water use. Water use appeared to reach a maximum around July 1. The peak water use per day was 0.13 inch. The average was much less.

Most of the water used from the profile by all crops was removed from the surface 9 inches (the depth of the A_p layer). Very few grass roots extended below 30 inches. The consumptive use of water under fescue sod was less than that under bluegrass. Frequent clipping of the grasses resulted in less total water use but a greater percentage use from the surface layer.

There was good correlation between the amount of water used from a horizon during a drying-out period and the amount present in the horizon at the beginning of that period. The correlation decreased with depth. It appears that the water was removed from the horizon where it was most abundant.

Weed, Brush, and Pest Control

Carlson, R. F. THE EFFECT OF CIPC ON FIELD SORREL IN STRAWBERRY PLANTINGS. Mich. Agr. Expt. Sta. Quar. Bul. 38: 365-367. 1956.

During the 1953 and 1954 seasons, CIPC was tested in Michigan for control of field sorrel in commercial strawberry plantings at 2 and 3 pounds per acre. The chemical was applied on Catskill and Premier varieties each year in October. The seedling field sorrel exhibited a wilted appearance but remained green for 2 months following the treatment. Well-established sorrel plants were not as noticeably affected. The following May, 60 to 70 percent of the seedling plants were dead, and the older plants appeared stunted in growth. Growth and yield of strawberry plants were not hampered by the CIPC fall treatment. For practical control of field sorrel in commercial strawberry plantings, CIPC should be applied at 2 pounds per acre in the fall when this weed is in the seedling stage.

Carlson, R. F. CMU AS A HERBICIDE IN VINEYARDS. Mich. Agr. Expt. Sta. Quar. Bul. 38: 409-412. 1956.

CMU was used successfully in 5 vineyards at 3, 6, and 9 pounds per acre and on 7 varieties of grapes. The results of using CMU in vineyards

during the 1955 season were similar to those obtained in 1954. Weed control was satisfactory at the 3-pound rate, and the 6- and 9-pound rates of CMU gave excellent weed control. Some yellowing of foliage occurred at the 6- and 9-pound rate where the soil was very light but this was temporary in nature. Fruit cluster and fruit type, color, and shape were normal at all locations, although there was some evidence of a slight delay in ripening at the 9-pound rate.

Davis, W. C. WEED KILLERS AND RICE. Tex. Agr. Expt. Sta. Prog. Report 1812. September 10, 1955.

Post-emergence applications at the acid equivalent rate of three-fourths pound per acre of 2, 4-D amine, Methoxone, 2, 4, 5-T amine, Silvex amine, and a Na salt of MCP applied to 24- to 65-day-old rice showed no significant differences or adverse effect on rice yields. All materials appeared to give satisfactory weed control. Post-emergence applications of phenoxytype herbicides on flooded and nonflooded rice stands did not show significant differences in yields; however, on the plots where the materials were applied when the rice was drained and the ground dry, the rice was 1 to 2 inches shorter than on plots that were flooded at the time of treatment.

Lee, W. O., and Timmons, F. L. EVALUATION OF PRE-EMERGENCE AND STUBBLE TREATMENTS FOR CONTROL OF DODDER IN ALFALFA SEED CROPS. Agron. Jour. 48: 6-10. 1956.

An experiment near Fielding, Utah, in 1954 evaluated 23 different chemical and burning treatments for control of dodder (Cuscuta spp.) in an alfalfa seed crop. Isopropyl N-(3-Chlorophenyl) carbamate or CIPC applied at 6 pounds per acre April 7 just as alfalfa was beginning growth reduced dodder seed yield 52 percent in first crop alfalfa seed and 79 percent in second crop alfalfa seed. This treatment increased alfalfa-seed yield 250 pounds per acre (about 500 percent) in first crop seed and 136 pounds per acre (about 250 percent) in second crop alfalfa seed.

Stubble treatments made June 18 following removal of the first crop alfalfa for hay gave dodder control as good or better than that from CIPC applications April 7 but alfalfa seed yields were less satisfactory. Burning alfalfa stubble with a knapsack kerosene burner gave 98-percent control of dodder but resulted in a relatively low yield of alfalfa seed.

Results from stubble treatments in 1954 were as good or better than those obtained in previous years. On the other hand, results from pre-emergence applications of CIPC were much less effective in 1954 than in 1953. Unusually dry weather and high temperatures during April and May 1954 apparently were largely responsible for these less satisfactory results.

Robinson, R. G., and Dunham, R. S. SPRAY PLACEMENT IN CORN AFTER LAYBY. Agron. Jour. 48: 35-37. 1956.

The importance of limited coverage of the corn plant when sprayed after the last cultivation with 2, 4-D, TCA, CMU, or Endothal is supported by these studied. Overall coverage of the corn plant soon after layby with high rates of 2, 4-D, TCA, CMU, or Endothal was very injurious, whereas spray coverage of only the lower 6 inches with TCA, CMU, or Endothal was not harmful. At the rate of 3 pounds per acre, 2, 4-D resulted in serious corn injury even when only the lower 6 inches were sprayed. Overall coverage of corn with 2, 4-D or TCA just after ear appearance was injurious but coverage of only the lower 12 inches was not harmful.

Stephens, J. C. REVIEW OF METHODS AND FORMULATIONS FOR AQUATIC WEED CONTROL. Soil Sci. Soc. Fla. Proc. XIV: 123-126. 1954.

This paper names and describes the principal equatic plants of south Florida and outlines the methods now in use for their control. The plants are classed as floaters, submerged aquatics, and emerged aquatics. The control measures discussed are (1) natural control methods; (2) control, using manual labor; (3) mechanical means of control; and (4) herbicidal or chemical control methods. The herbicides are divided into contact, soil sterilants, and systemic.

Forestry, Woodlots, Shelterbelts

Alexander, R. R. TWO METHODS OF THINNING YOUNG LODGEPOLE PINE IN THE CENTRAL ROCKY MOUNTAINS. Jour. Forestry 54: 99-102. 1956.

Two methods of thinning 35-year old lodgepole pine on the Fraser Experimental Forest were examined: (1) single tree that cut all but 630 trees per acre, spaced 8.5 feet apart; and (2) crop tree that cut openings 16 feet in diameter around the best 100 trees per acre, and left standing the trees outside the cleared circle. Eight years after treatment, comparisons of average diameter growth were made between the 100 crop trees on the crop-tree plots and 100 similarly selected trees on the single-tree and unthinned plots.

Although single-tree thinning showed better initial growth, it is more expensive to use because more trees must be cut, more time spent selecting leave trees, and the treatment may have to be repeated. Crop-tree thinnings are, therefore, recommended where small trees cut cannot be sold, and the whole cost of thinning must be recovered through increased stumpage values at time of final harvest.

Barnes, R. L., and Ralston, C. W. SOIL FACTORS RELATED TO GROWTH AND YIELD OF SLASH PINE PLANTATIONS. Fla. Agr. Expt. Sta. Tech. Bul. 559. 1955.

To study the correlation between the growth of planted slash pine and soil productivity, sample plots were established on 269 plantations of slash pine throughout Florida. On each plot, data were collected to obtain the rate of height growth of the trees; the soil profile was described and sampled. An additional 101 sample plots were measured to obtain data on the rate of cordwood volume growth as related to site quality and spacing.

Statistical analysis of the data showed that the height growth of slash-pine plantations in Florida can be estimated from two easily measured properties of the soil profile: (1) Depth to a fine-textured horizon and (2) depth to a mottled horizon. These two variables accounted for 89 percent of the total variation in height at a given age, and thus provide a convenient method of estimating the site quality of land for planted slash pine.

Byrnes, W. R., and Brauble, W. C. GROWTH AND YIELD OF PLANTATION-GROWN RED PINE AT VARIOUS SPACINGS. Jour. Forestry 53: 562-566. 1955.

The growth and development of plantation-grown red pine spaced 5 by 5, 6 by 6, 6 by 8, and 10 by 10 feet in central Pennsylvania have been reported at 16 and 25 years. This third report describes the conditions of these spacing plots when 30 years of age.

Diameter growth these 30 years has been consistently in favor of the wider spacings of 6 by 8 and 10 by 10 feet. At 30 years the average d. b. h. of trees in the 10 by 10 spacings was 2.44 inches larger than that for the generally used spacing of 6 by 6 feet. Average d. b. h. of trees in the 6 by 8 spacing was 0.74 inch larger than that of the 6 by 6 feet.

Davey, C. B. TRANSFORMATIONS OF SAWDUST IN THE SOURCE OF ITS DECOMPOSITION UNDER THE INFLUENCE OF Coprinus ephemerus. Soil Sci. Soc. Amer. Proc. 19: 376-377. 1955.

Sawdusts of jack pine, sugar maple, and red oak were treated with anhydrous ammonia, neutralized with H_3PO_4, enriched with K_2SO_4, and inoculated with Coprinus ephemerus. Compost mixtures were prepared in earthenware jars in greenhouse cultures at 2-week intervals to permit simultaneous analysis of composts at various stages of decomposition.

The results of chromatographic analysis indicated that C. ephemerus is not selective in its sugar utilization, although it consumes hemicellulose somewhat earlier than alpha-cellulose. A chromatogram of the hydrolysate of C. ephemerus showed almost exclusively glucose.

DeLong, W. A., and Schnitzer, M. INVESTIGATIONS ON THE MOBILIZATION AND TRANSPORT OF IRON IN FORESTED SOILS: I. THE CAPACITIES OF LEAF EXTRACTS AND LEACHATES TO REACT WITH IRON. Soil Sci. Soc. Amer. Proc. 19: 360-363. 1955.

Methods for estimating the capacities of aqueous solutions derived from forest litter and forest canopy to retain Fe in solution and to bring the Fe of freshly precipitated ferric hydroxide into solution (true or colloidal) are described and results presented. The amount of Fe retained or brought into suspension depends on the source of the solution, or the pH and the nature of the dominant cation present, and on the proportion of Fe to organic matter in the system.

Foiles, M. W. EFFECTS OF THINNING A 55-YEAR-OLD WESTERN WHITE PINE STAND. Jour. Forestry 54: 130-132. 1956.

Results of this test provide useful information on thinning western white pine. The thinnings had little effect on total volume production but enhanced the volume of the stand by increasing the proportion of high value white pine in it. They stimulated diameter growth of dominant and co-dominant stems but not at a rate that resulted in an appreciably greater number of large diameter trees than those on the check plot.

Forristall, F. F., and Gessel, S. P. SOIL PROPERTIES RELATED TO FOREST COVER TYPE AND PRODUCTIVITY ON THE LEE FOREST, SNOHOMISH COUNTY, WASHINGTON. Soil Sci. Soc. Amer. Proc. 19: 384-389. 1955.

Five 1/10-acre plots were established on Lee Forest to investigate forest site and type and soil relationships. One plot was in each of the following types and sites: western hemlock-Douglas fir, site class III; Douglas fir, site class II; Douglas fir, site class III; western red cedar, site class III; red alder, site class I.

Soils were sampled on these plots and the following data taken: effective depth, bulk density, texture, moisture equivalent, reaction, total N, and cation-exchange capacity. In addition, weight and N content of the forest floor were determined and soil moisture followed throughout the 1953 growing season.

Depth to a hardpan layer was an important criterion for productivity rating. High bulk densities impeded root growth and determined effective soil depth. The critical density differed for the different tree species. Total soil N and total cation-exchange capacity were much greater in the more productive forest soils. The western red cedar and red alder plots had shallow soils with excess soil moisture during much of the year. Low soil moisture did not appear to be a factor in tree growth on any of the plots in the 1953 growing season. The dominating influence in determining forest type seemed to be poor soil drainage.

Gessel, S. P., and Walker, R. B. HEIGHT GROWTH RESPONSE OF DOUGLAS FIR TO NITROGEN FERTILIZATION. Soil Sci. Soc. Amer. Proc. 20: 97-100. 1956.

This paper presents the results of initial N fertilization trials on 15- to 20-year old natural Douglas fir stands growing on poor sites (site class IV, V) in western Washington. Annual height growth was used as the criterion of response. On both shallow residual and deep glacial outwash soils response to N was very marked. Larger more vigorous trees responded more than smaller trees and resulted in more rapid suppression of these small trees. Foliage color changed from yellow to dark green after fertilization and before height growth response. Nitrogen content of needles increased from less than 1 percent to 1.2 to 1.8 percent after fertilization. Some aspects of fertilization of forest lands are discussed, including use of fertilizers for Christmas tree production.

Heiberg, S. O., and White, D. P. A SITE EVALUATION CONCEPT. Jour. Forestry 54: 7-10. 1956.

The authors emphasize consideration of all effective factors which influence production of trees throughout the life of the stand, and the dynamic rather than the static nature of site quality is stressed. They claim site is a complex composed of many factors influencing the development of a forest. A forester must be aware of all the effective factors that contribute to this development. Site is not static; it is dynamic. Site varies from period to period, from year to year, and man influences site greatly. Site is the sum of all the effective factors among which one or more are dominant.

Horn, A. F. A SIMPLIFIED METHOD FOR ESTIMATING FORM CLASS OF LOBLOLLY AND SHORTLEAF PINE STANDS IN MISSISSIPPI. Jour. Forestry 54: 185-187. 1956.

Average stand form class of loblolly and shortleaf pine saw timber in Mississippi can be measured by the ratio of the diameter inside bark at 7 feet above ground divided by the diameter over bark at 2.25 feet above ground on groups of 20 trees or more. On this basis the estimated average form class will be within ± 2 form class numbers of the actual average form class. This method is limited to saw timber sized stands of average or better density.

Knox, R. L. FOREST INVENTORY FOR MANAGEMENT OF STATE LANDS IN MINNESOTA. Jour. Forestry 54: 123-129. 1956.

An important consideration in this survey is the write off of volume, which is in the harvest class, but classified as nonoperable. This method uses the individual stand as the basic survey unit, the individual type as a basic unit, acreage data obtained through complete type mapping from aerial photographs, and field checking all merchantable stands as well as many other types. It also has other advantages.

Kozlowski, T. T. TREE GROWTH, ACTION AND INTERACTION OF SOIL AND OTHER FACTORS. Jour. Forestry 53: 508-512. 1955.

Marked differences in growth characteristics of forest tree species exist which indicate that the length of growing season and shape of growth curves are controlled more by hereditary factors than by environment. Height growth of trees is completed in many areas during only a small part of the frost-free season. For individual species, diameter growth begins later and lasts longer than does height growth. Growth cycles and seasonal rhythms in diameter growth, carbohydrate content, and water content of wood were demonstrated.

Changes in environmental factors influence growth, only within limits imposed by hereditary potentialities, by affecting internal physiological processes and conditions of a tree.

The roles of soil water, aeration, fertility, and temperature are evaluated briefly in terms of their effects on production of photosynthate and ultimately on growth. Efficiency of physiological processes varies with species under fluctuations of environmental factors.

A complex of environmental factors, including climatic, soil, and biotic factors, affects tree growth. The effects are interacting, interdependent, and reciprocal.

Leaf, A. L., and Keller, T. TENTATIVE TECHNIQUE FOR DETERMINING THE INFLUENCE OF SOIL ON THE GROWTH OF FOREST PLANTATIONS. Soil Sci. Soc. Amer. Proc. 20: 110-112. 1956.

This paper reports analytical techniques for the determination of the influence of soil on the growth of red pine and white spruce plantations. The ecological homogeneity of the plantation or portion thereof is checked by a transect survey of tree heights and diameters and soil analysis. The estimate of the rate of growth is made on the basis of stem analyses of the average sample trees. The field and laboratory investigation of soil properties is supplemented by foliar analysis and, in the case of hydromorphic soils, by the determination of properties of ground water. The importance of an accurate estimate of the density of nurse stands is stressed. The applicability of suggested methods is illustrated by concrete examples.

Lemmon, P. E., Johnson, R. A., and Krauter, O. SITE INDEX CURVE FOR LODGEPOLE PINE IN THE PUMICE AREA OF CENTRAL OREGON. Jour. Forestry 53: 553-555. 1955.

This is a report of a survey being conducted in the pumice soils area of central Oregon to determine the relationships between forest and range sites, soils, and other environmental factors. This is a site-soils correlation study. The purpose is to determine the productive capacity of the land for tree species and for forest and forage types when in excellent or near climax conditions. Productive capacity for timber is obtained qualitatively by determining the site index. When properly referenced to a yield study, site index becomes a quantitative measure of productive capacity.

This paper presents a growth curve, a site-index table, and site-index curves for lodgepole pine based on measurements made in natural, unmanaged stands.

Lloyd, W. J., Schlots, F. E., and Deardorff, C. E. FOREST MANAGEMENT PRACTICES AS RELATED TO AND INFLUENCED BY FOREST SOIL DIFFERENCES IN WESTERN WASHINGTON. Soil Sci. Soc. Amer. Proc. 20: 105-107. 1956.

In developing correlations between soil and site quality for Douglas fir, observations were made on other forest-management factors which appeared to be related to the soil. Presence or absence of windfall was noted on each plot. Nearby cutover areas of the same soil were checked for abundance of regeneration and for encroachment of hardwoods. On soils with cemented or compacted subsoils, checks were made for occurrence of natural seedlings and for their proximity to old stumps as an indication of micro-site differences in seedling receptivity. In addition to site quality, susceptibility or resistance to windthrow, susceptibility to hardwood brush encroachment, abundance of conifer regeneration, seasonal use limitations, and other management factors are strongly influenced by the soil profile properties.

Management should be varied to capitalize on the good or desirable factors and to eliminate or minimize the undesirable ones. Forest-growth patterns are described for widely different soils, and specific forest-management recommendations are given to illustrate the tailoring of management to fit individual soils.

Lowry, G. L., and Youngberg, C. T. THE EFFECT OF CERTAIN SITE AND SOIL FACTORS ON THE ESTABLISHMENT OF DOUGLAS-FIR ON THE TILLAMOOK BURN. Soil Sci. Soc. Amer. Proc. 19: 378-380. 1955.

This paper presents a preliminary report of studies dealing with soil-moisture-seedling survival relationships conducted on the Tillamook Burn in northwestern Oregon during 1953. Ten 1/5-acre plots were selected from the current year's planting program. Survival was calculated on the basis of total trees planted.

Factors investigated include: Percent slope, aspect, soil texture, structure, depth, organic-matter content, and range of available moisture. Weather data were obtained from nearby lookouts. Soil-moisture determinations were made weekly throughout the summer.

Although there were not enough plots to establish statistical significance, certain factors were affecting survival. Among these were aspect, percent slope, and soil texture. Southerly aspects coupled with coarse-textured soils and slopes greater than 40 percent showed the highest mortality. On the other hand, northerly aspects, loam and silt loam textures, and slopes less than 40 percent had excellent survival. Between these two extremes various gradations existed. In all cases where high mortality occurred, soils had been depleted of available moisture (below 15 atm.) for periods approaching 30 days.

Mignery, A. L. FACTORS AFFECTING SMALL-WOODLAND MANAGEMENT IN NACOGDOCHES COUNTY, TEXAS. Jour. Forestry 54: 102-105. 1956.

This study indicated that landowners who undertook timber management did so on properties that were reasonably well stocked. These owners derived substantial income from sources other than their woodlands, and therefore, were not pressed to cut immature growing stock. Landowners in this area must be induced to practice forestry while they still have pine timber to work with. Once their woodlands shrink to a sea of hardwood brush, most owners shrink from the long waiting period necessary to rebuild desirable growth stock.

Miller, W. D., and Tissue, O. C. RESULTS OF SEVERAL METHODS OF RELEASE OF UNDERSTORY LOBLOLLY PINE IN UPLAND HARDWOOD STANDS. Jour. Forestry 54: 188-189. 1956.

In two growing seasons after the release of understory loblolly pine from upland hardwoods by felling and by poisoning with Ammate: (1) Height growth of pines up to 9 feet tall at time of treatment was doubled as a result of treatment: (2) growth in diameter breast high was quadrupled; and (3) the different treatments showed little variation in their effects on growth, but felling caused more damage to young pines than did treatment with Ammate. Felling was also much more expensive than Ammate treatment but the cost of felling may be recovered if a market for fuelwood or pulpwood is available.

Nienstaedt, H., and Graves, A. H. BLIGHT RESISTANT CHESTNUTS CULTURE AND CARE. Conn. Agr. Expt. Sta. Cir. 192. 1955.

The American chestnut is a total loss as a forest tree both as a timber producer and as a source of wildlife food. The development of blight resistant hybrid chestnuts as a forest crop is still in an experimental stage but the work has reached the point where the planting of Chinese chestnut as an orchard crop or as a source of game food in the woods can be considered. As yet material is not available for timber production, but in small openings in the woods and along fence rows a few trees can be planted. With a limited amount of care they will produce a very valuable source of food for the game.

The outlook for Chinese chestnut as an orchard crop is good. In many areas test plantings are already established and in some commercial orchards are in operation. In regions where Chinese chestnuts have not been planted previously it might be well to start with small scale plantings. If they develop satisfactorily, planting on a large scale would be a possibility.

Olson, C. E., and Bay, R. R. REPRODUCTION OF UPLAND, CUTOVER SPRUCE-BALSAM-HARDWOOD STANDS IN MINNESOTA. Jour. Forestry 53: 833-835. 1955.

Natural regeneration in the upland, cutover white spruce-balsam-fir-hardwood stands examined were adequate, both in numbers and distribution. Balsam fir and quaking aspen were the most abundant species in the young stand. The proportion of white spruce declined and all other coniferous species, with the sole exception of balsam fir, disappeared. Hardwood yields, particularly with respect to quaking aspen, were expected to be much greater than those in the past, and the combined yields from balsam fir and white spruce should equal the corresponding yields of the last cut.

Reynolds, R. R. MANAGED GROWTH. U.S. Dept. Agr. Sou. Forest Expt. Sta. Occasional Paper 142. 1955.

This is a report of a study involving selection management on a 958-acre tract of loblolly-shortleaf pine-hardwoods on the Crossett Experimental Forest near Crossett, Ark. It attempts to determine the growth possibilities in a variably stocked loblolly-shortleaf pine stand containing an abundance of low-grade hardwoods; if these possibilities can be realized in a reasonable time; if income can exceed management expenses during the development period; and what will be the costs and returns from management.

Tables of growth are presented from 24 managed forties representing a wide range of stocking. The striking growth under management suggests the advisability of shortening the developmental period of the stand as much as possible.

Roth, E. R. DECAY FOLLOWING THINNING OF SPROUT OAK CLUMPS. Jour. Forestry 54: 26-30. 1956.

Three hundred and seventy-four sprout clumps of mixed oak species were thinned by removing one or more stems from the clumps by methods commonly used in fuelwood, mine props, or noncommercial thinning operations. The diameter growth of all the residual trees from which companion sprouts were removed was 69 percent greater than unthinned ones, even though no attempt was made to think the study areas systematically. Comparing Pennsylvania treated trees with close-by untreated trees, the growth was only 31 percent greater.

Schlots, F. E., Lloyd, W. J., and Deardorff, C. E. SOME SOIL CHARACTERISTICS WHICH AFFECT ROOT PENETRATION AND TIMBER SITE QUALITY OF DOUGLAS FIR IN WESTERN WASHINGTON. Soil Sci. Soc. Amer. Proc. 20: 101-105. 1956.

This study was initiated to determine the relationships between soil properties and site quality for Douglas fir in Western Washington. The ultimate objective is to predict timber-site quality and desirable management practices directly from soil survey maps.

Forest-production measurements and soil profile descriptions were obtained concurrently on 203 sites representing 14 soil types. Profile properties of 5 soil types are discussed in detail to show by comparison their relationship to rate of tree growth. The highest timber site quality was produced on sites with deep, friable soils of moderate to high fertility level. Progressively lower timber-site quality was reflected on sites with increasing strong profile development or degree of horizonation. There is a close relationship between timber-site quality and soil depth over claypan, fragipan, and hardpan horizons. Soils having similar profiles, though developed from different parent materials, have similar site qualities.

The data collected provide a sound basis for assigning average site indices to the different soil types included in this study.

Factors of slope, aspect, position, and landform are more important in woodland regeneration, management practices, and logging operations. Most important to productive-site quality is the combination of properties which determine soil type.

Schnitzer, M. and DeLong, W. A. INVESTIGATIONS ON THE MOBILIZATION AND TRANSPORT OF IRON IN FORESTED SOILS. II. THE NATURE OF THE REACTION OF LEAF EXTRACTS AND LEACHATES WITH IRON. Soil Sci. Soc. Amer. Proc. 19: 363-368. 1955.

Electrodialysis of poplar leaf extracts enriched with Fe indicated that the major part of the Fe was present either as ferric hydroxide or

in a form readily convertible to the latter. Interaction of such solutions with Fe produced only a general increase in light absorption; no absorption maximums indicative of chelation were observed. The major part of the Fe present in these enriched aqueous solutions could be recovered by extraction with 8-quinolinol in chloroform.

Fractions isolated from poplar leaf extracts and leachates by precipitation in 80-percent aqueous ethanol possessed the major part of the capacities of these solutions to react with Fe. Evidence was obtained that the principal component of these active fractions had the characteristics of an acidic polysaccharide. Potentiometric titrations of these active fractions in presence and absence of ferric ions failed to reveal evidence of chelation.

It is concluded that both the forest canopy and the forest floor contribute solutions capable of the mobilization and transport of Fe. Conclusions are drawn relative to the conditions favorable to such action of these solutions.

Schopmeyer, C. S., and Larson, P. R. EFFECTS OF DIAMETER, CROWN RATIO, AND GROWTH RATE ON GUM YIELDS OF SLASH AND LONGLEAF PINE. Jour. Forestry 53: 822-826. 1955.

Multiple regression estimates of gum yields from Pinus elliotii, Engelm., and P. painstris, mill. showed, for trees with a diameter between 9 and 14 inches, that a 10-percent increase in crown-length ratio increased gum yields about 38 barrels (435 lbs. each) per crop of 10,000 trees. For any crown-length ratio between 0.20 and 0.50 an increase in diameter of 1 inch increased gum yields about 27 barrels per crop. For any diameter within the range of 9 to 14 inches, an increase in average size width of 0.01 inch in the last inch of radial growth increased gum yield 11 barrels per crop.

Skog, R. E., and Barber, L. R. FINANCIAL RETURNS FROM LOGGING RECENTLY TAX-DELINQUENT FOREST LAND. Mich. Agr. Expt. Sta. Quar. Bul. 38: 471-477. 1956.

Recently, the Upper Peninsula Experiment Station harvested 983 cords of pulpwood and other products from a 440-acre tract of forest land which it acquired as tax-delinquent land at no cost in 1943. In 1943, the tract probably could have been purchased for $1,500 by a private individual.

Most of the products harvested were cut from mature and overmature aspen, balsam fir, spruce, and some old logging remnants, all scattered throughout a 60-year-old stand of northern hardwood that covers most of the area. Returns to the station from the sale of stumpage grossed $2,473 and netted $2,020. Gross returns to the operator from the sale of products totaled $18,549.

Net returns to the operator after deducting all logging costs, including the cost of his own and hired labor, amounted to $1,944. Evaluation of returns based on the assumption that the operator could have done all the woods work himself indicates that his return for labor and enterprise would have amounted to a total of $12,039, or $1.35 on an hourly basis.

The area is still stocked with a stand of hardwood trees that can be managed on a sustained yield basis so that it will provide periodic income from future harvests of timber.

Slocum, G. K., and Maki, T. E. SOME EFFECTS OF DEPTH OF PLANTING UPON LOBLOLLY PINE IN THE NORTH CAROLINA PIEDMONT. Jour. Forestry 54: 21-25. 1956.

Four separate tests, 2 exploratory and 2 main experiments, were conducted on the Hill Demonstration Forest, Durham County, N. C., to determine the effect of various planting depths on survival and growth of 1-0 loblolly pine seedlings. All plantings were made in well-drained upland Piedmont soil. Survival was not significantly affected by any depth of stem buried, but those seedlings with one-fourth of the root system exposed did show significantly greater mortality in the 1952 test and grew less in height. In all deep-planted seedlings, current height growth was stimulated and growth differences continued to be significant for 2 years after planting. Degree of stem burial had no effect on the original root system; the deeply buried roots did not die, nor did new rootlets develop above the root collar on the buried stem.

Staple, W. J., and Lehane, J. J. THE INFLUENCE OF FIELD SHELTERBELTS ON WIND VELOCITY, EVAPORATION, SOIL MOISTURE AND CROP YIELD. Canad. Jour. Agr. Sci. 35: 440-453. 1955.

Five years' measurements of the influence of field shelterbelts on wind velocity, evaporation, soil moisture, and crop yield are described. The speed of cross winds was reduced to a distance at least 20 times the height of the trees. This reduction in evaporation near the shelterbelts was small and appeared to have little or no influence on soil-moisture conservation or crop yield. Snow accumulation near shelterbelts ranged from almost 0 to drifts 70 feet wide. The snowdrifts increased the soil moisture at seeding time resulting in increased crop yields as compared with those from the center of the field. The net increase in yield for one group of sheltered fields for the 5 years (taking into account the area occupied by the trees) was 0.7 bushel per acre.

Steinbrenner, E. C., and Gessel, S. P. THE EFFECT OF TRACTOR LOGGING ON PHYSICAL PROPERTIES OF SOME FOREST SOILS IN SOUTHWESTERN WASHINGTON. Soil Sci. Soc. Amer, Proc. 19: 372-376. 1955.

Nine areas of recent tractor logging with adjacent undisturbed mature timber were selected for sampling. Samples were obtained from the undisturbed timber which was used as a control, tractor roads, and tractor cutover on each of these areas. The latter included all of the area not in the major skid-road system. The samples consisted of 3-inch-soil cores taken at the surface with a special sampling tool. Soil permeability rate, bulk density and pore-space distribution were determined for each sample in the laboratory.

Results showed that the soils from the tractor cutover had a 35-percent loss in permeability rate, a 2.4-percent increase in bulk density and a 10-percent decrease in macroscopic pore space when compared to the timber control. The tractor roads showed a 93-percent loss in permeability, a 15-percent increase in bulk density, and a 53-percent loss in macroscopic pore space. The areal extent of the tractor skid roads in this study was 26 percent of the logged area.

Stephens, E. P. THE UPROOTING OF TREES: A FOREST PROCESS. Soil Sci. Soc. Amer. Proc. 20: 113-116. 1956.

For many years the uprooting of trees has been recognized as a natural phenomenon. As such, it has usually been regarded as one of freakish occurrence noted for its direct and catastrophic results upon the trees immediately affected. Uprooting, it seems, has seldom been considered with enough perspective to reveal its basic relationship to the forest.

A form of very detailed descriptive research was instigated in 1948 to document the developmental trends of the forest stands which had occurred on a 1-acre area. Uprooting was established conclusively as an important factor in the development of the area during the last 500 years.

When uprooting is observed and interpreted on a limited area with the perspective afforded by 500 years, its role becomes that of a natural forest process, rather than a single event in the life history of a forest stand. As a process, it must be considered along with reproduction, growth, podsolization, and other generally recognized processes. Similarly, the series of actions and subsequent reactions associated with uprooting can be described quantitatively, qualitatively, and chronologically.

Stoeckeler, J. H., and Macon, J. W. REGENERATION OF ASPEN CUTOVER AREAS IN NORTHERN WISCONSIN. Jour. Forestry 54: 13-16. 1956.

A survey of 46 cutover-aspen stands was made in northern Wisconsin in 1947-50 to determine their adequacy of stocking with aspen and other species at 2 to 9 years after loggings and to correlate the amount and growth of reproduction with the residual stand. Complete clear cutting produced the most abundant sprout regeneration and resulted in the best height growth. Aspen reproduction per acre ranged from 2,827 sprouts on rather open sites with good sunlight conditions resulting from heavy cutting to as little as 377 on sites with heavy residual cover. Annual height growth of aspen sprouts ranged from 1.37 feet in the open to 0.40 foot in heavy shade. Sprouting of aspen was quite abundant in many areas where the volume of harvested aspen was 3 or more cords per acre and moderately abundant where only 2 cords were cut per acre. Abundance of aspen sprouting is related to the basal area of the residual stand. The number of sprouts per acre ranged from 2,720 on clear-cut areas and 1,000 sprouts at 20 square feet of basal area to as low as 580 sprouts at 40 square feet of basal area.

Stoeckeler, J. H., and Scholz, H. F. A CYLINDRICAL SCREEN FOR PROTECTING DIRECT SEEDING OF FOREST TREE SPECIES. Jour. Forestry 54: 183-184. 1956.

A large cylinder was devised for studying natural reproduction of yellow birch which may require protection for periods of from 3 to 5 years in certain types of experiments. This unit, covering 2 square feet of area, is 19.15 inches in diameter, 24 inches in height, and has a rectangular cap 20 by 24 inches. Both the cylinder and cap were cut from 24-inch hardware cloth.

The top is held in place by 4 pieces of copper wire. In weeding operations or counts, 3 of these wires are removed, and the 4th acts as a hinge on which to swing the cover.

Stone, E. L., and Baird, G. BORON LEVEL AND BORON TOXICITY IN RED AND WHITE PINE. Jour. Forestry 54: 11-12. 1956.

Boron toxicity in the pine studied is readily identifiable by characteristic symptoms and the high foliar content of the element. On the acid sandy soils, symptoms were induced by borax applications as low as 10 pounds per acre. At the 50-pound rate, symptoms were conspicuous but the percentage of total foliage area affected was still relatively small.

Thames, J. L., Stoeckeler, J. H., and Tobiaski, R. SOIL MOISTURE REGIME IN SOME FOREST AND NON-FOREST SITES IN NORTHERN WISCONSIN. Soil Sci. Soc. Amer. Proc. 19: 381-384. 1955.

The soil-moisture regime was studied in 2 paired sets of sites in northern Wisconsin.

In comparison of a forested and nonforested Spencer silt loam there was less available soil moisture in the surface 1 to 2 feet of the forested site because of heavy depletion of soil moisture

by the tree stand, as compared with the nearby site with a timothy hay crop. Bulk density of the soil in the hay land was 25 percent greater for the top foot and 32 percent greater for the top 2 feet than the forested site.

In a comparison of 2 paired forested sites both on sands and with permanent water table at 2.0 and 4.5 feet, respectively, there was around 0.4 inch more water in the surface foot in the former, or around 4 percent on a weight basis in the top 2 feet during much of the growing season. Jack pine has almost the same site index on both sites, but in the case of aspen, the site index was 10 feet greater on the shallower water-table area.

Trousdell, K. B., and Hoover, M. D. A CHANGE IN GROUND-WATER LEVEL AFTER CLEARCUTTING OF LOBLOLLY PINE IN THE COASTAL PLAIN. Jour. Forestry 53: 492-498. 1955.

Ground-water observation wells were dug in adjacent compartments of the Bigwoods Experimental Forest, Hertford County, N. C., in June, 1950. Soils and topography are similar in the two compartments, and the wells are about 350 feet apart. The soil is a Bladen silt loam. In July 1952, the loblolly pine-hardwood timber around one group of wells was clearcut. As a result of this cutting, the water table rose to higher levels for the rest of the growing season than it did where a forest stand was left. This same relationship was maintained during the 1953 growing season.

The ground-water profile, determined from a line of 10 temporary wells, emphasized the impermeability of the Bladen soil. The water table was lowered under a timber stand and under a 1-chain uncut strip but at 1/2-chain or more into the clear-cut areas the water table was not lowered by the adjacent timber.

The results of these studies may have a practical significance in developing silvicultural systems for the poorly drained soils of the Coastal Plain and throughout the flatwoods, where surface drainage is extremely slow. Heavy cutting may conceivably create soil conditions unfavorable for successful seedling establishment. If this proves to be the case, other systems of cutting that will have less immediate effect on soil moisture and groundwater levels may be needed in particular areas.

Voigt, G. K. THE EFFECT OF APPLIED FUNGICIDES, HERBICIDES AND INSECTICIDES ON THE CONTENT OF NUTRIENT ELEMENTS IN TISSUE OF CONIFEROUS SEEDLINGS. Soil Sci. Soc. Amer. Proc. 19: 237-239. 1955.

The effect of different eradicating agents used in nursery practice on the contents of N, P, Na, Ca, and Mg in needle tissue of coniferous tree seedlings was investigated. Jack pine (P. banksiana) and Monterey pine (P. radiata) were raised in nursery seed beds and greenhouse-pot cultures on soils treated with biocides used singly and in combinations at different rates of application. The biocides investigated included Al sulfate, calomel, formaldehyde, thiosan, allyl alcohol, Stoddard oil, benzene hexachloride, and chlordane.

Responses of the seedlings ranged from a stimulation of growth and an increase in the content of nutrients to a severe depression of the rate of growth accompanied by a reduction depression of the rate of growth and a reduction in the content of nutrients. The results of the study indicate that tissue analysis may serve as a useful tool in determining the effect eradicating agents on the availability of nutrient elements to tree seedlings.

Wahlenberg, W. G. AN EARLY TEST OF LEVELS OF GROWING STOCK IN APPALACHIAN HARDWOODS. Jour. Forestry 54: 106-114. 1956.

Appalachian hardwood old-growth with dead chestnuts removed was cut in 1937 to levels of stocking ranging from 0 to 10M board-feet per acre. Results were gaged by reinventory of reproduction 7 years later and growing stock 15 years later.

Regeneration of light-seeded species increased with the intensity of cutting in the overstory. Yellow poplar seeds are well disseminated by wind but the germination is low and the seedlings prefer a moist site. This species did not reproduce well on dry sites under any stand condition. Sweet birch likewise reproduced best on heavily cut and moist sites. These and the other desirable species, as a group, had a natural tendency to maintain or increase their relative position in the stand, at least on the better sites.

Walker, L. C. FOLIAR ANALYSIS AS A METHOD OF INDICATING POTASSIUM-DEFICIENT SOILS FOR REFORESTATION. Soil Sci. Soc. Amer. Proc. 19: 233-236. 1955.

Foliar analysis is useful in indicating soils deficient in K for normal growth of certain conifers. Exchangeable K in Adirondack sand plains of glacial outwash origin was related to K in foliage of Pinus strobus, Fagus grandifolia, Populus tremuloides, Fragaria virginiana, and Andropogon gerardi. Foliar K decreased as the season progressed for Pinus strobus, Acer rubrum, and Prunus virginiana. Plants fertilized with KCl were analyzed for comparison. Exchangeable K, acid-soluble P, total N, organic matter, and pH analyses for soils are reported.

Weitzman, S., and Trimble, G. R., Jr. A CAPABILITY CLASSIFICATION FOR FOREST LAND. Jour. Soil and Water Conserv. 10: 228-232. 1955.

Following an oak-site study made in the northern Appalachians, forest-land-capability classes for hardwoods were developed. Four land factors were closely related to productivity of forest lands. They are: aspect, topographic position, steepness of grade, and soil depth. The effect of certain minor modifying factors is also described.

These land-capability classes can be used as aids in determining the intensity of management practices and the frequency of cutting and in estimating the value of timberland. The type and intensity of management that is suitable for each capability class is suggested.

Wilde, S. A., and Peršidsky, D. J. EFFECT OF BIOCIDES ON THE DEVELOPMENT OF ECTOTROPHIC MYCORRHIZAE IN MONTEREY PINE SEEDLINGS. Soil Sci. Soc. Amer. Proc. 20: 107-110. 1956.

Sandy nursery soil of siliceous outwash, autochthonously inoculated with mycorrhizal fungi, was treated with chlordane, benzene hexachloride, thiosan, calomel, formaldehyde, Al sulfate, allyl alcohol, and Stoddard solvent at the rates common in nursery practice. After incubation, the cultures were planted to surface-sterilized seed of Pinus radiata, and the external and internal development of mycorrhizal short roots was recorded at definite intervals. The internal alterations of mycorrhizae under the influence of eradicants were characterized by irregularities in the shape of the fungal mantle, restricted penetration of mycelia, and reduced development of the Hartig net. The external modifications of the short roots suggested that biocides cause radical changes in the exudates of rhizospheric organisms. The effect of eradicants varied with the nature of chemical compounds and their rate of application but some of the observed modifications of mycotrophic organs were symptomatic of the eradicants applied.

Woodruff, H. P. THE SPACING INTERVAL FOR SUPPLEMENTAL SHELTERBELTS. Jour. Forestry 54: 115-122. 1956.

Wind-tunnel studies were conducted to obtain information on the mechanical reduction of wind velocity and a system of shelterbelts consisting of a principal belt followed by supplemental belts. Models of 7-, 3-, and 1-row principal belts, and 1-, 2-, and 3-row supplemental belts were used to obtain the information. Results are expressed in terms of percentage reductions of the open wind velocity. Information was obtained with several different spacings of the supplemental belts when used with a principal belt. Some results of tests on the so-called narrow plantings, i.e., single rows used without the benefit of a wide principal belt, are also given.

Wycoft, H. B. METHYL BROMIDE FUMIGATION OF AN ILLINOIS NURSERY SOIL. Jour. Forestry 53: 811-813. 1955.

The 2-percent inventory of 2-0 red pine seedlings in 1953 revealed that 8,800 feet of fumigated seedbed produced 4,914 red pine 2-0 per square foot, while 21,376 feet of unfumigated seedbed produced 27.2 per square foot with the same seeding rate.

Youngberg, C. T. SOME SITE FACTORS AFFECTING THE SUCCESS OF REFORESTATION AND AFFORESTATION ACTIVITIES IN THE WILLAMETTE VALLEY FOOTHILLS. Soil Sci. Soc. Amer. Proc. 19: 368-372. 1955.

This paper reports some preliminary findings of the studies of soil-moisture relations and the physical factors affecting them on several areas where reforestation or afforestation has been attempted. Soil profile descriptions are given, and results of laboratory analysis including mechanical analysis, bulk density, range of available moisture, and nutrient status are also reported. Several seasonal soil-moisture curves are presented. The results of the study suggest that the narrow range of readily available moisture, i.e., water held at low tensions, in many of the soils of this area is responsible for the difficulties in reforestation and afforestation.

Economics of Conservation

Anonymous. DEVELOPMENT OF AGRICULTURE'S HUMAN RESOURCES. U.S. Dept. Agr., Wash., D.C. April 1955.

This study has been focused on farm people--their needs, their goals, and the obstacles they encounter. The principal cause of concentrations of farm people with low earnings is the inadequate agricultural resources in certain areas rather than any lack in the people themselves.

This study sets up no goals other than those voluntarily chosen by the people. The basic philosophy is that people will make wise decisions if they are informed regarding their various opportunities and if their capabilities are enhanced so as to increase the number of choices available to them. Insofar as individuals make wise decisions the national welfare will be advanced.

Special attention was focused on the young people in the belief that they stand to gain most from a program which will increase the number of opportunities, the awareness of them, and capacities to take advantage of them.

Baumann, R. V., Heady, E. O., and Aandahl, A. R. COSTS AND RETURNS FOR SOIL-CONSERVING SYSTEMS OF FARMING ON IDA-MONONA SOILS IN IOWA. Iowa St. Col. Res. Bul. 429: 449-480. 1955.

Conservation and improvement of the soil is one of the foremost problems facing farmers on the hilly Ida-Monona and associated soils that border the Missouri River bottom lands in western Iowa. Some changes in the present systems of farming, which center around grain crops and drylot fattening of cattle and hogs, are necessary to control serious gully and sheet erosion.

Several alternative ways are suggested by which old gullies can be controlled, new gullies prevented, and the productivity of the soil maintained or improved. These are: use of crop rotations which include more acres of grass and legumes; a combination of better rotations and such practices as terracing and contouring; and a combination of better rotations, mechanical erosion-control practices, and fertilizer. On 160-acre farms use of rotations alone to control erosion would limit the acreage of grain to about 35 acres of corn and 25 acres of oats. Although about 95 acres of hay and pasture in the crop rotation would increase the yields per acre of grain crops, the percentage decreases in acreage of grain would be much greater and total production of grain would be lowered. Total production of forage would be increased because of the larger acreage, but the increase in forage production would not be enough to offset the decrease in grain production.

A soil-management system built around improved rotations, terraces, and contouring would include about 50 acres of corn, 34 acres of oats, and 70 acres of hay and pasture on 160-acre farms. This system of conservation farming would produce more feed than is normally produced with present systems, except on those farms on which 50 percent or more of the cropland is used for corn.

Bierman, R. W. U. S. MORTGAGED FARMS 1950. U. S. Dept. Agr. Agr. Res. Serv. ARS 43-13. 1955.

This report presents data on mortgaged farms classified by ratio of debt to value. The data are estimates based on information on data for the 1950 Census of Agriculture and in a cooperative farm-mortgage survey conducted in 1951 by the Bureau of the Census, United States Department of Commerce, and the former Bureau of Agricultural Economics, United States Department of Agriculture.

Bishop, C. E., and Sutherland, J. G. RESOURCE USE AND INCOMES OF FAMILIES ON SMALL FARMS, SOUTHERN PIEDMONT AREA, NORTH CAROLINA. N. C. Agr. Expt. Sta., Dept. Agr. Econ. AE Inform. Ser. 30. February 1953.

This study was intended to determine the incomes of families living on small farms in the Southern Piedmont and to appraise these incomes in terms of the incomes that these people might obtain by alternative uses of their resources. Two groups of small farms were studied--part-time farms, and small commercial farms. In 1950, the average total net revenue of families living on part-time farms was about the same as the revenue of those living on representative medium-size commercial farms in the area and more than twice as large as that of families living on the small commercial farms. Labor is the most abundant resource on small farms. About 7 of the 24 million man-hours of labor in the labor force on part-time farms were underemployed in 1950, as compared with 17 of the 34 million man-hours on small commercial farms. The extent of underemployment of labor on small farms varies with the seasons. During peak periods, the entire labor force works full time, but during other periods more than half the labor is underemployed. Off-farm work can supplement farm employment but there is little seasonal variation in such employment. The return for labor employed in nonfarm uses exceeds the return for labor employed in farmwork. The labor force on the small farms was similar to that on the larger farms in the area. Because of the industrial growth in the South, and the consequent increase in wage rates and nonfarm employment opportunities, there has been a large outmigration from agriculture. Productivity of labor in agriculture can be increased to a level equal to the return labor can earn in nonfarm employment only by making changes in the farming systems.

Botts, R. R. FARM MUTUAL REINSURANCE. U. S. Dept. Agr. Agr. Inform. Bul. 119. 1953.

Much of this bulletin is devoted to a description of reinsurance programs sponsored by State associations of mutual insurance companies in 13 States. Such programs are operating in California, Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Nebraska, New York, North Dakota, Ohio, South Dakota, and Wisconsin. In these States, reinsurance is available for fire (and lightning). In Nebraska and Wisconsin, reinsurance is available against windstorm damage also. No reinsurance program sponsored by a State association is in operation with respect to the crop-hail hazard. Between 1940 and 1950, farm property valuations more than doubled.

These increased valuations were accompanied by higher replacement costs and, therefore, a need for more insurance by farmers. The increased amounts often exceed the single-risk limitations that are acceptable to farm mutuals. Thus, specific-risk reinsurance is greatly needed if farmer members are to receive adequate coverage of high-valued buildings and equipment. The inclusion of protection against wind damage by many farm fire mutuals has made reinsurance of that peril also more necessary if company losses, and members' insurance costs, are to remain relatively stable between years.

Brodell, A. P., and Kuzelka, T. J. HARVESTING THE SILAGE CROPS. U. S. Dept. Agr. Statis. Bul. 128. 1953.

The material in this report is based on information supplied by voluntary crop correspondents of the United States Department of Agriculture in February 1952. The tonnage of each of the different kinds of silage produced on their farms in 1951, and the tonnages of silage chopped with field forage and stationary harvesters were reported. About 6,500 farms, with 9,000 permanent silos were included. About 750,000 tons of silage were produced on these farms in 1951. By far the greatest tonnages of corn, sorghum, and grass silage were harvested with field forage harvesters.

Brodell, A. P., and Walker, H. R. HARVESTING CORN FOR GRAIN. U. S. Dept. Agr. Statis. Bul. 129. 1953.

The information in this report relating to methods of harvesting corn for grain in 1951 was obtained from voluntary crop correspondents of the United States Department of Agriculture in February 1952. About 16,500 farms, producing 550,000 acres of corn were included in the study. Three methods of harvesting were used--the mechanical field-type picker; from the standing stalk by hand; and by husking or snapping from the shock. Harvesting with mechanical corn-pickers was the leading method in the North Central and Western States. For the country as a whole, about 68 percent of the acreage was machine-picked.

Crecink, J. C., and Bice, S. A. MAKING A LEASE FOR AN IRRIGATED FARM. Colo. Agr. Expt. Sta. Bul. 431-A. 1953.

Data for this study were obtained from mail questionnaires distributed by the Colorado Agricultural Extension Service in 1951; from detailed records obtained through personal interviews in the spring of 1951 in the Northeastern Colorado Irrigated Area; and from farm-record accounts maintained by the Colorado Agricultural Experiment Station. Points to be considered in making a lease for an irrigated farm are listed. A good lease is especially important to irrigation farmers in this area as a majority are either tenants or rent part of the land they farm. The contributions approach for arriving at rental arrangements is discussed. Under this method, total farm income is divided in the same proportion that each party contributes to total farm expenses--cash and noncash.

Garlock, F. L., and Hutton, R. F. BANK FINANCING OF DAIRY FARMERS IN NORTHERN VERMONT. U. S. Dept. Agr. Agr. Inform. Bul. 129. 1954.

Chosen for study were 10 banks--5 national banks and 5 savings banks and trust companies--in the part of Vermont that lies north of Rutland and Orange Counties. These 10 banks each had a relatively high percentage of agricultural to total loans. They were chosen to obtain cases that would involve many problem situations. The banks in the area apparently can well provide the types of credit dairy farmers need, that is, credit to buy, improve, stock, and equip their farms. These farmers need relatively little credit to meet current operating expenses. Loans, for the most part, extend from a few months to several years. Farmers must offer specific security for most loans but the loans are not always limited to a maximum percentage of security value. Although most of the banks gave farmers excellent service, it is suggested that they might have improved their services by (1) using participation loans to a greater extent; (2) adapting formal maturities of loans more closely to the needs of borrowers; and (3) informing themselves more fully as to the financial condition, farming operations, plans, and problems of their farmer-borrowers.

Gilcrease, R. M. ELECTRICITY--HOW MUCH? WHAT FOR? ON FARMS IN NORTHCENTRAL NORTH DAKOTA. N. Dak. Agr. Expt. Sta. Bul. 379. 1952.

A study made in 5 counties of north-central North Dakota showed that by June 30, 1952, nearly 80 percent of the farms had been connected with central station power, as compared with only about 10 percent on January 1, 1945. In this cash-grain section of the State, 2 main factors influenced the amount of electricity used on farms--the length of time the farm has been electrified, and the amount of farm income. On farms electrified before 1940, average annual consumption increased from 1,598 to 5,191 kilowatt-hours from 1940 to 1949. On farms electrified in 1940, average annual consumption increased from 1,501 to 5,419 kilowatt-hours. Farms with the higher incomes had the highest consumption. They were usually the larger farms with more equipment for household and farm uses. In 1949 average annual consumption per farm ranged from 1,952 kilowatt-hours on farms having gross incomes of less than $4,000 to 7,464 kilowatt-hours on farms with annual in-

comes of more than $20,000. Neither size of family nor tenure of the farm operator had any appreciable effect on the amount of electricity used. Frugality or liberality in use of energy was a major factor affecting the total amount used. Choice of equipment showed a uniform pattern. Radios, washing machines, and irons were reported on 96 percent of all farms. Nearly 90 percent had refrigerators. Of the nonhousehold items, cream separators were the most frequently used. About 40 percent had pressure water systems. About 86 percent of the total energy used was used for household purposes and about 14 percent for farm operators. Consumption of electricity on farms in this area was expected to increase.

Gray, J. R., and Baker, C. B. ORGANIZATION, COSTS, AND RETURNS ON CATTLE RANCHES IN THE NORTHERN GREAT PLAINS, 1930-52. Mont. Agr. Expt. Sta. Bul. 495. 1953.

This is the fourth of a series of publications reporting organization, production techniques, costs, and returns of commercial family operated ranches in the Range Livestock Area of the northern Great Plains, and part of a nationwide study of commercial family operated farms in major agricultural areas of the United States. The proportion of owned land in these commercial family operated cattle ranches decreased from 50 percent in 1929 to 41 percent in 1940, then increased to 69 percent in 1952. Cattle on January 1 ranged from 124 head in 1937 to 143 head in both 1945 and 1947. Marketing of cattle was irregular. Most of the cattle marketed were yearlings. The estimated value of investment on these ranches averaged about $16,000 in the midthirties and about $90,000 in 1952. From 48 to 68 percent was real estate. From 1930 to 1939 the average annual net ranch income was $230. In the 1940's and early 1950's, the return was in excess of $4,000 annually in 10 of the 13 years. In 1949, because of the severe winter and drought, the net income dropped below this figure. Total cash expenditures ranged from about $1,200 in 1932 and 1933 to about $7,700 in 1951. In analyzing the beef cattle enterprise apart from minor ranch enterprises, the estimated total expense of producing 100 pounds of beef ranged from $3 in 1933 to about $15 in 1951.

Hansing, F. D., and Gibson, W. L., Jr. BECOMING A FARM OWNER. IS IT MORE DIFFICULT TODAY? Va. Agr. Expt. Sta. Bul. 473. 1955.

The study reported here was conducted in Culpeper and Orange Counties, Va. It included 160 farmers who owned farms averaging 251 acres in size, with business valued at about $41,000 at the end of 1951. The object was to find how these farmers acquired the capital for their initial investment; to learn how future rate of capital accumulation was related to the method used in acquiring the initial capital; and to determine the effect of the size of the initial investment, size of the farm, age and education of the operator, and productivity of the soil on the farmer's success in attaining full ownership. In 1950, capital investments on these farms averaged more than $30,000. About two-thirds of these owners were helped to acquire ownerships of their farms through family financial assistance. This took the form of inheritance, a loan of capital for purchase of the farm, or an opportunity to work on the home farm until enough capital was accumulated to finance a farm business. About a third of the farmers studied, or 60, received no family assistance. They acquired enough capital to make down payments on their farms through nonfarm employment, borrowing, or climbing the traditional agricultural ladder. Farmers who received family help began with farms valued at around $7,000, in which they had a 66-percent equity. By 1951 they had an 89-percent equity in farms valued at around $15,000. Those who began without family help began with a 52-percent equity in a $6,500 farm business and rose to an 84-percent equity in a $14,012 business. Economic conditions in the years following acquisition of the farms and the productivity of the soil were important in explaining the individual variations in capital accumulation after the initial ownership is acquired.

Hecht, R. W. LABOR FOR FARMWORK, 1955. U.S. Dept. Agr. Agr. Res. Serv. ARS 43-21 revised. February 1956.

Estimates of the man-hours of farmwork for 1955 that were presented in the original version of this report were based chiefly on the September 1955 Crop Production report of the Agricultural Marketing Service. The annual summary Crop Production report released in December indicated that 1955 production of many crops was significantly higher than that envisaged by the September report. It was deemed desirable, therefore, that the estimates of man-hours of labor be revised to conform with current estimates of acreage and production.

Hedges, T. R., and Bailey, W. R. ECONOMICS OF MECHANICAL COTTON HARVESTING. A REPORT OF STUDIES MADE IN THE SAN JOAQUIN VALLEY. Calif. Agr. Expt. Sta. Bul. 743. 1954.

California growers are rapidly mechanizing their cotton picking. Between 1946 and 1951 the number of machines increased from 25 to 3,700, and the portion of the crop picked by machine increased to 54 percent. With this rapid development of a new harvesting method many technical and economic problems have arisen. Compared with the economic costs of harvesting cotton by

hand, those of mechanical harvesting include the cost of machine picking, the reduction, if any, in grade and value of the cotton, and the additional field waste, if any, that is attributable to the machine.

Interviews were held with 63 growers who had used machines in 1949 to obtain information on use of machines, cost of picking, and gin turnout. Used at full season's capacity, 31 machines picked an average of 292 bales on 356 acres of picking in 520 hours of operation. From this, a machine could be expected to harvest completely 200 acres or about 300 bales of cotton in a typical season. Gin turnout of machine-picked cotton was 36.5 percent, less than 1 percentage point below the turnout of handpicked cotton. Cost of machine picking averaged $14.65 per bale harvested based on a season pick of 229 bales. For a season pick of 300 bales, the cost would be $12.29 per bale. Full use of the machine is important. The machine-picked cotton averaged slightly less than one full grade below handpicked cotton. It also averaged low in value, although differences in grades and values varied widely among areas and among gins.

Helfinstine, R. D. STATISTICAL SUPPLEMENT--ECONOMIC POTENTIALS OF IRRIGATED AND DRYLAND FARMS IN CENTRAL SOUTH DAKOTA (SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION BULLETIN 444). Agr. Economics Pamphlet 67. Nov. 1955.

This supplement presents in more detail the budgets summarized in South Dakota Agricultural Experiment Station Bulletin 444. These details should be useful to research and other agricultural workers and those farmers interested in working out budgets for their own farm under similar conditions.

Hoglund, C. R. HIGH QUALITY ROUGHAGE REDUCES DAIRY COSTS. Mich. Agr. Expt. Sta. Spec. Bul. 390. 1954.

A study of the roughage production and feeding practices carried out on 34 southern Michigan dairy farms showed a wide range in both the quality or roughage produced and the cost of producing milk. It cost farmers who harvested and fed roughage of excellent quality 46 cents less to produce 100 pounds of milk than it did those who used poor quality roughage. The quality of roughage was affected by the percentage of legumes in the stand, the maturity of the material when harvested, and the methods of harvesting and storing used. Harvesting as grass silage or barn-dried hay gave better roughage than field-curing and hay-loader methods. About $8 more per acre was needed to produce excellent roughage than that needed to produce poor roughage, but the cost per ton was less because of the greater yield of feed nutrients from the former. High-legume, well-fertilized pastures were the cheapest source of feed. The cost of feed was reduced by 30 to 40 percent when cows were turned out on pasture. Most dairymen found it profitable to supplement pastures with good quality grass silage, hay, or corn silage in late July, August, and September.

Hoglund, C. R. CONSERVATION PROGRESS AND PROBLEMS ON MICHIGAN FRUIT FARMS. Mich. Agr. Expt. Sta. Quart. Bul. 36: 261-269. 1954.

This article discusses the problem of using the combination of production practices that will result in high yields of quality fruit and at the same time will conserve the soil. It is a difficult problem. Recommendations for improved soil management provide for substantial increases in orchard sod, cover crops, mulching, contour farming, and other such practices. But application of some of these practices, particularly sod, may actually reduce the yields of fruit if management is poor or if supporting practices are not used. Often orchards are on sites that are most subject to erosion from wind and water. A study was made in 1952 of the conservation problems and the progress in establishing conservation practices on 46 typical fruit farms in the Grand Traverse and St. Joseph River Soil Conservation Districts. Progress in applying parts of the conservation plans made for these farms varied from farm to farm. Of the cooperators in each district, 75 percent said their plans were workable. Cover crops were generally used but few fruit growers were enthusiastic about orchard sod. Many of them thought sod had a place in their orchards if they learned how to handle it. Contour planting was followed on 1 in 12 acres in both districts. Mulching was not used extensively nor were sod buffer strips or alternate middles. The growers listed desirable aids to speed up adoption of conservation practices.

Hoglund, C. R. SOIL CONSERVATION IN MICHIGAN. PROGRESS AND PROBLEMS. Mich. Agr. Expt. Sta. Spec. Bul. 394. 1955.

What progress have Michigan farmers made in adopting soil and water conservation practices? What additional methods would help to attain greater application of improved practices? What are the problems that these farmers must solve in applying conservation practices?

To try to find answers to these questions, 157 planned (cooperating in a soil conservation district program) farms and 119 nonplanned farms in Barry, Hillsdale, Livingston, Osceola, and Tuscola Counties were studied. The study showed that from 70 to 80 percent of the cooperators in each of the 5 soil conservation districts believed that their farm plans were workable, even though on many farms additional work was needed to put parts of the plans in operation. The remaining 20 to 30 percent had decided that the changes in farm organization and practices provided for in

their initial farm plans were too drastic or were not sufficiently flexible.

From 10 to 30 percent of the cooperators in each of the 5 districts had adopted essentially all of the component parts of the farm plans. An additional 50 percent or more had made substantial progress in applying one or more parts of the plan. The progress was made in the 5 to 7 years before 1952. Cooperators in each district, except those on cash-crop farms in Tuscola County, attained about 60 percent of the planned acreage of sod crops, the basic part of each farm plan. Tuscola County cash-crop cooperators attained only a third of the planned acreage of these crops. In the 3 districts in which they were studied, noncooperators made only minor changes in acreages of hay and rotation pasture. In Tuscola and Hillsdale Counties, about 50 percent and in the other counties 20 percent or less of the acreage of green-manure and cover crops planned was seeded. Contour tillage and stripcropping were planned to a limited extent in Livingston and Osceola Counties. Livingston County farmers applied about 85 percent of the planned acreage of these practices. Osceola County farmers had applied about 70 percent of the stripcropping planned but only 55 percent of the contour tillage. Neither of these practices was applied to any extent on nonplanned farms. By 1952 more than 65 percent of the tile drainage planned had been completed in Tuscola, Hillsdale, and Livingston Counties. District cooperators tested their soil for lime to a greater extent than noncooperators.

Hole, E., and McPherson W. W. FARMING IN THE COASTAL PLAIN OF NORTH CAROLINA. N. C. Agr. Expt. Sta., Dept. Agr. Econ. AE Inform. Ser. 47. December 1955.

This study is based on an economic analysis of farming from 1940 to 1954 in an area of 14 counties in the Coastal Plain of North Carolina. Major changes in production, resource employment, and farm incomes are measured and explained. For purposes of analysis and illustration these farming systems, which represent the most common size and type of units, were used (1) average tobacco-cotton farms, (2) large tobacco-cotton farms, and (3) small tobacco farms.

Janssen, M. R., and Robertson, L. S. ECONOMIC EFFECTS OF CROPPING AND LIVESTOCK SYSTEMS ON A ROLLING CENTRAL INDIANA FARM. Purdue Univ. Sta. Bul. 625: 3-23. 1955.

Based on a study of the rundown 160-acre Jones farm in central Indiana, it was found that adoption of profitable systems of farming with improved cropping and livestock systems and conservation measures would increase labor income more than $2,400. Transition from the present system to the long-run plan can be made with a higher cash farm income than the present system except for 1 or 2 years when fertilizer purchases are large.

Jones, L. A., and Garlock, F. L. FACTORS AFFECTING FARM LOAN INTEREST RATES. U. S. Dept. Agr. Agr. Inform. Bul. 126. 1954.

This bulletin reviews some of the principal factors affecting interest rates on Government and corporate securities traded in the open market and on loans of farmers and others. Open-market rates for different securities vary with such factors as tax features, size and marketability, and risk or soundness of the security. Open-market rates change frequently and are sensitive to changes in general economic activity and in governmental policies that affect banking and credit. For the last 20 years or more interest rates in the open market on securities with short-term maturities have been lower than rates on long-term maturities. Rates of interest on loans to farmers and others are influenced somewhat by the same factors that influence "open market" rates. But loan rates are more stable; they are insulated to a large extent against open-market forces by local customs in lending and by local factors which affect the cost and risk of making loans. Interest rates on long-term loans to farmers are usually lower than short-term rates, mainly because of less expense over the long run in handling and servicing such loans.

Lindsey, Q. W. FARM TENURE: THE FRAMEWORK FOR LONG-RUN ADJUSTMENTS IN SOUTHEASTERN AGRICULTURE. N. C. Agr. Expt. Sta. Tech. Bul. 110. 1954.

Since 1920 the trend in the Southeast has been toward fewer farms with more of them operated by full owners and part owners. Tenants and croppers have declined in number. The average acreage in farms operated by full and part owners has increased and the average size of tenant and cropper units has declined. With the increased progress of mechanization since 1940 in the Southeast, the operators who farm the largest acreages--full and part owners and managers--have mechanized more rapidly than have tenants and croppers. The farm-mortgage situation has changed somewhat since 1930. The percentage of farms with mortgages in the 3 tenure groups--full owners, part owners, and tenants and managers--has declined since the high reached in 1940, although after 1945, the percentage apparently leveled off. Length of occupancy of farms varies with the type of tenure. Tenants and croppers move frequently. The average age of farm operators has increased, with the average age of full owners increasing most. Most of the adjustment in the land factor in the last 20 years or more has come about through the absorption by full and part owners of land formerly operated by tenants and croppers.

Are further adjustments possible? Two areas in which distinctly different types of adjustment have occurred were selected for study. Available evidence suggests that farmworkers in the Southeast are fully as capable as farmworkers in other sections of the United States, that the productive capacity of the land exceeds present levels of production by a considerable margin, and that increased capital investment in machinery, livestock, and buildings is profitable. Therefore, further long-run adjustments in the agriculture of the Southeast are possible. The problem is largely one of synchronizing the functions of the existing tenure framework with the rapidly changing economic conditions.

Strand, E. G., Heady, E. O., and Seagraves, J. A. PRODUCTIVITY OF RESOURCES USED ON COMMERCIAL FARMS. U. S. Dept. Agr. Tech. Bul. 1128. 1955.

Striking differentials exist in returns to the production resources that are used on commercial farms in this country. Analysis of the 68 productivity regions delineated in this report provides a basis for appraising the magnitude of these differences as they existed in the relatively prosperous year of 1949.

Along with data on the characteristics and interrelationships of the resources used, three principal measures of the productivity of specific resources or groups of resources were developed. These are residual returns per man-equivalent worker, residual returns per dollar of investment, and the ratio of the value of total output to the value of all inputs.

From the standpoint of both analytical and welfare considerations, differences in returns per man-equivalent operator and family worker for labor and management are significant. Among the regions here delineated, this return ranged from less than $300 to almost $16,000. The average for the United States was $1,156.

Sutherland, J. G., and Bishop, C. E. POSSIBILITIES FOR INCREASING PRODUCTION AND INCOMES ON SMALL COMMERCIAL FARMS, SOUTHERN PIEDMONT AREA, NORTH CAROLINA. Tech. Bul. 117. 1955.

The purpose of this report is to present estimates of the production and income possibilities on small farms.

Within the limits imposed by a set of assumptions that approximate the resource conditions that exist on small farms, and on the basis of improved production practices, budgetary and linear programing techniques were used to establish approximate potential net revenues on Southern Piedmont small farms with 15, 27, and 50 acres of cropland. Most of the optimum organizations include laying hens, cotton, corn, oats, lespedeza, and alfalfa. The size of the individual enterprise varies from one organization to another. Potential net revenue ranges from about $5,800 on nonmechanized farms with 15 acres of cropland using family labor only to $10,350 on mechanized farms with 50 acres of cropland using family labor and one full-time hired man.

Thorfinnson, T. S., and Epp, A. W. EFFECT OF PUMP IRRIGATION ON FARMS IN CENTRAL NEBRASKA. Nebr. Agr. Expt. Sta. Bul. 421. 1953.

The effects of pump irrigation on 147 farms in central Nebraska were studied in 1952. Many of the farmers had been irrigating for only a few years. Forty-seven percent had irrigated for 1 to 5 years; 40 percent for 6 to 10 years; and 4 percent for 16 or more years. The most obvious effect of irrigation on these farms was the increased production of crops. The increased stability in yields of crops was no less important. The advantages of irrigation differed with the different farms. For example, on farms where practically all crops were sold, irrigation increased the net income each year and served as partial insurance against failure in dry years. On farms where crops were fed to livestock, irrigation helped to stabilize the feed supply and to keep farm income on a more even keel. Irrigation has given farmers the opportunity to keep more livestock, although more than 75 percent of the farms were not stocked to the capacity of the feed supply. It is estimated that net returns may be increased about as much on these farms by irrigating 80 acres now in the farm as by adding another quarter section of dry-farming land to the present holdings.

United States Department of Agriculture. CHANGES IN FARM PRODUCTION AND EFFICIENCY, ANNUAL SUMMARY, 1955, SUPPLEMENT III. U. S. Dept. Agr. Agr. Res. Serv. ARS 43-15, Supp. III. 1955.

The purpose of this supplement is to provide additional data on changes in farm production per man-hour in each geographic division.

Van Arsdall, R. N., and Cleaver, T. HANDLING SILAGE AND CONCENTRATES FOR BEEF CATTLE IN DRYLOT. Ill. Agr. Ext. Serv. Cir. 714. 1954.

To find ways of saving time and heavy work in feeding cattle a study was made of 36 Illinois farms on which cattle were an important part of the systems of farming. Farms were chosen on which silage was fed, as the use of silage adds to the work of cattle feeding. These farms differed as to type of silo used, feeding arrangements, size of herd, equipment used, and method of operation. On many farms the feeding plant could be made more efficient with only a few changes and with the use of the equipment already on the farm. On other farms, buildings and yards would need to be rearranged, facilities for feed storage and handling changed or added, and new power tools and equipment bought. Four

plans were worked out for different-sized herds: (1) Wagon distribution of silage and grain for 200 cattle; (2) carrier distribution of concentrates and silage for 50 to 75 cattle; (3) self-feeding silage for 35 to 40 cattle; and (4) self-feeding grain for 125 cattle. The plans are based on the most practical and efficient setups studied, plus refinements found through experiments.

Van Arsdall,. R. N., Ibach, D. B., and Cleaver, T. ECONOMIC AND FUNCTIONAL CHARACTERISTICS OF FARM DAIRY BUILDINGS. Ill. Agr. Expt. Sta. Bul. 570. 1953.

A survey of 350 dairy farms in the Illinois part of the Chicago and St. Louis dairy areas showed that investments chargeable to the dairy enterprise on these farms totaled $3.8 million. Of this amount, almost half was in dairy buildings. Size of herd appeared to affect investments in buildings very little. Low-cost buildings were as likely to provide good service as high-cost buildings. In general, operators who produced Grade A milk maintained more efficient buildings than did those who produced the lower grades. Efficiency of buildings was associated with size of herd, and age and structural level of the buildings. Annual dairy costs averaged $26 per dairy-animal unit. Of this sum building costs amounted to only 10 percent. However, the influence of buildings on labor efficiency, productivity of the herd, and quality of milk must be considered also. About $300 return per dairy-animal unit was needed on these farms to cover all costs, including those of buildings. Although in this study the efficiency of management could not be rated, the inventory that was made of management practices showed that improvement was most needed sanitation and use of labor. Most of the operators interviewed had stall barns, which generally could not be changed or expanded economically. But they were interested in loose housing, which would be more serviceable, less expensive, and easier to adapt to changing needs than the buildings they now have.

Voelker, S. MINERAL RIGHTS AND OIL DEVELOPMENT IN WILLIAMS COUNTY, NORTH DAKOTA. N. Dak. Agr. Expt. Sta. Bul. 395. 1954.

The discovery of oil in North Dakota in 1951 and the subsequent speculation in mineral rights have emphasized the importance of prudent management of mineral rights by landowners. The most common methods by which interests in oil and gas in their natural state may be held are (1) mineral rights incident to the ownership of land, mineral rights conveyed by deed, or mineral rights retained by reservation; (2) mineral rights under oil and gas leases granted by the mineral owners; and (3) royalty interests under royalty assignment or royalty reservation. A mineral interest is an ownership of part of the realty. The oil and gas lessee has whatever rights are granted him by the lease from the mineral owner, in return for which he agrees to pay the mineral owner and annual rental stated in the lease. Mineral rights may be separated from surface rights and fractionalized among several owners by mineral deeds and by mineral reservations in deeds to land. From May 1948 to May 1, 1952, nearly 1,100,000 acres in Williams County were placed under oil and gas leases. By May 1, 1952, mineral reservations in land sales had been responsible for separating mineral rights from surface rights in more than 263,000 acres. By May 1, 1952, also, mineral rights had been separated at least in part on about 30 percent of the land in farms. If the trend toward separation and fractionalization continues, the oil industry will find it more costly to negotiate new leases when present leases expire. This may result in lower average bonuses and rentals for mineral owners under the new leases. A landowner who sells subsurface rights exchanges the possibility of receiving future returns for present income. He also runs the risk of incurring certain future costs and disadvantages. A mineral right in an undrilled tract has two value elements--lease and royalty--whereas a royalty right has only royalty value. This bulletin describes a method by which landowners can estimate these values.

Whatley, T. J., and Atkins, S. W. INCREASING INCOMES THROUGH FARM ADJUSTMENTS IN THE GRENADA-LORING SOIL ASSOCIATION AREA OF SOUTHERN WEST TENNESSEE. Univ. Tenn. Sta. Bul. 244: 5-94. Dec. 1955.

This report presents and evaluates alternatives to the present systems of farming.

In developing alternative systems of farming, it was assumed that the present acreage of the representative farms would not change. The total volume of production, however, would be increased by reorganizing the farm and adopting improved production practices. Both of these measures would require more capital.

Biology

Gysel, L. W., and Lemmien, W. THE GROWTH AND WILDLIFE USE OF PLANTED SHRUBS AND TREES AT THE W. K. KELLOGG MULTIPLE USE FOREST. Mich. Agr. Expt. Sta. Quar. Bul. 38: 139-145. 1955.

From 1937 to 1939, during the establishment of the W. K. Kellogg Multiple Use Forest in southwestern Michigan, a variety of conifers, deciduous trees, and shrubs were planted on abandoned farmland. An analysis of the growth and wildlife value of 7 of the shrubs and trees on good sites of the area is presented. These plant species are: indigobush amorpha, Siberian peashrub, silky dogwood, multiflora rose, Tar-

tarian honeysuckle, Russian olive, European mountainash.

Survival and growth of the plants was generally good. Each of the plantings added to the diversity of cover in the area. The densest summer and winter cover for animals near the ground was provided by Tartarian honeysuckle and multiflora rose. The indigobush amorpha was the only planting to increase in size from seedlings and root suckers.

The different plant species added to the diversity of food available to wildlife during the summer, fall, and winter. All species produced a large amount of fruit in 1953 and less in 1954.

From trapping records and observations there is evidence that a variety of animals, mainly small insectivors, rodents, and songbirds were associated with each of the plantings. The only plant species intensively used, however, was multiflora rose which was utilized by cottontails, deer, or songbirds for both food and cover throughout most of the year.

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